Over grazing and improper grazing techniques adjacent to Cascade Reservoir (right) have been replaced with proper grazing and reestablishment of riparian vegetation (left).

Compendium of Best Management Practices To Control Polluted Runoff

A SOURCE BOOK

Joan Meitl and Todd Maguire, Editors

March 2003

COVER PHOTO CREDIT: BARRY ALBERT

Compendium of Best Management Practices To Control Polluted Runoff

A SOURCE BOOK

First Edition, March 2003

Joan Meitl and Todd Maguire, Editors

Table of Contents

Introduction

One source of pollution of our nation's waters is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural pollutants and pollutants resulting from human activity, finally depositing them into lakes, rivers, wetlands, and ground waters. In addition, hydrologic modification can also adversely affect the biological and physical integrity of surface waters.

The control of polluted runoff can be a complex process. Polluted runoff may originate from more than one type of land use and from many sources, and may include a variety of contaminants, transported by different delivery mechanisms. Each of these variables complicates the search for a set of practices that will provide a cost-effective solution. The effectiveness of many management practices is determined by a variety of factors such as land use, site conditions, cost, and maintenance requirements. The strategic choice and placement of the appropriate practices or systems of practices in the watershed are critical to their success in reducing the input of individual pollutants and improving water quality.

There are many sources of information for the wide variety of management practices that can be used to protect, maintain, or enhance water quality. Much of the information in this document has been adapted from information developed by the U.S. Environmental Protection Agency. While much information is available, finding the best set of management practices for a particular problem can be a time-consuming and confusing process. Knowing how to select the most appropriate practices from among the many options available further complicates the process.

The purpose of this document is to provide an overview of practices to control polluted runoff and a broad framework for selecting the appropriate practices for a specific situation. Many kinds of activities within a watershed are potential sources of polluted runoff. In this document, these activities have been divided into seven sectors: agriculture, silviculture, hydrologic modification, mining, urban/storm water runoff, transportation, and marinas and recreational boating.

This document is designed to help watershed managers, land treatment personnel, watershed advisory groups, and others interested in water quality to identify and select best management practices appropriate for their situations. This document can be used as a tool by local governments, governmental entities, nongovernmental organizations, and the general public in planning and implementing water quality programs.

The Compendium is designed to provide the reader with an introduction to the process of characterizing a water quality problem an overview of the types of practices that can be used for water quality protection or remediation, and a discussion of the factors that should be considered when selecting practices. The remaining sections of this

document provide information about the following land and water use sectors:

- **SECTION 2** Agricultural Activities
- **SECTION 3** Silviculture Activities
- **SECTION 4** Hydrologic and Habitat Modification Activities
- **SECTION 5** Mining Activities
- **SECTION 6** Urban Activities/Storm Water Runoff
- **SECTION 7** Transportation Activities
- **SECTION 8** Marinas and Recreational Boating Activities

Included in each of these sections is an overview of the activities that can be sources of polluted runoff and the pollutants that they can potentially generate. The pollutants can potentially affect surface water and ground water. Both potential pathways must be considered in selecting the best approach to control pollution. Each section includes a discussion of the types of practices available to prevent or remediate pollution from the activities within that sector.

For each of the seven land and water use sectors, a list of pollutant control practices is provided in a table at the end of the section. These practices are organized by the category of activities to which they apply. For instance, biotechnical stabilization, a practice used to control sediment, is located under the subheading of Active Mining in the table for Mining Activities. The list of practices is not all-inclusive and does not preclude the use of other technically sound practices.

A definition of each management practice can be found in the glossary in Appendix A. When this document is viewed electronically, the reader can click on the name of a practice in each table and it will connect automatically to a description of the practice in the glossary. More detailed information about specific practices and their applicability can be found in other documents that are referenced in Appendix B. A hot link is provided to this information at the beginning of each table and can be accessed by clicking on "Additional Sources of Information." Most of this information can be accessed online. It can also be obtained by contacting the agencies listed in Appendix C.

Factors that affect the applicability of a practice include the targeted pollutants and the control mechanism of the practice (source control versus treatment). Each table is organized using these factors as column headings for which the definitions listed here are used.

TARGETED POLLUTANTS

- **Bacteria:** This category includes both bacteria and viruses.
- **Nutrients:** This category includes the two most common nutrients: nitrogen and phosphorus.
- **Dissolved Oxygen:** This category represents the activities and the most common substances in the form of organic matter that reduce the available oxygen in water.
- **Floatables:** The most common floatable materials are trash and yard waste. Floatable materials can also contain significant amounts of heavy metals, toxic chemicals, and bacteria.
- **Hydrocarbons:** This category includes petroleum-derived substances, particularly oil and grease that contain hydrocarbons.
- **Temperature:** This category includes thermal pollution problems that are a result of anthropogenic activities. Nonpoint sources include changes in channel or water body size, sediment, reduction in streambank and overstory vegetation, irrigation return flows, irrigation withdrawals, stormwater runoff, low flow, hydromodification, and unusually hot regional temperatures.
- **Toxics:** This category includes organic compounds such as pesticides, paints, solvents, adhesives, or other similar products and heavy metals such as lead, copper, cadmium, and zinc.
- **Sediment:** This category is the most common pollutant. Sediment can also carry other pollutants such as nutrients, toxic chemicals, and heavy metals.

MECHANISM: SOURCE CONTROL

- **Managerial/Operational:** Pollutant control through modification of behaviors, processes, or activities.
- **Good Housekeeping:** Pollutant control by keeping a clean site, through practices such as neat and orderly storage of materials, regular waste disposal, prompt cleanup of spills, and cleanup of sediments that have been tracked by vehicles or have been transported by wind or water about the site or onto nearby roadways.
- **Collection/Conveyance:** Pollutant control through the collection and/or transport of wastewater or runoff to minimize erosion, prevent contact with a pollutant, or provide treatment or discharge.
- **Containment:** Pollutant control through the collection and containment of runoff or wastewater for treatment or disposal.
- **Reduction/Elimination:** Pollutant control through the reduction or elimination of an existing or potential contaminant.
- **Protection:** Pollutant control through covering materials or wastes to prevent contact and dispersal by wind or water.
- **Stabilization:** Pollutant control through properly placing, grading, and/or covering soil, rock, or earth to ensure its resistance to erosion, sliding, or other movement.

MECHANISM: TREATMENT CONTROLS

- **Biological Treatment:** A treatment process in which biological activity removes or inactivates a contaminant.
- **Chemical Treatment:** A treatment process in which chemical interactions remove or inactivate a contaminant.
- **Filtration:** A treatment process in which suspended matter is removed from a liquid through a medium which is permeable to the liquid but not to the suspended material.
- **Infiltration:** A treatment process where the penetration of water through the ground surface into sub-surface soil removes contaminants from water by filtration, biological activity, absorption, or adsorption.
- **Sedimentation:** A treatment process in which soil particles, clays, sands, or other sediments that are carried by flowing water are deposited.

The tables at the end of Section 2-8 can be used in several ways. For instance, if the sector (land use) and targeted pollutants are known, the reader can refer to the table for that sector to identify specific activities that can contribute the targeted pollutants, practices may be applicable and their control mechanisms. When the objective is to minimize or prevent pollutants from a proposed activity, applicable control practices for the activity of concern can be found under the subheading in the table for the appropriate sector.

Problem Identification

One of the most critical steps in controlling polluted runoff is to correctly identify and document the existence of the water quality problem or potential problem. The water quality problem may be defined either as a threat or impairment to the designated use of a water resource. The diffuse nature of polluted runoff, and its spatial and temporal variability, makes it a difficult problem to treat. Pollutant sources can be difficult to identify and impacts may be subtle. Therefore, without adequate water quality problem documentation, polluted runoff cannot be successfully controlled.

The first step in identifying and documenting a water quality problem is to gather existing data on the water resource and the watershed. Water resource information may be gleaned from past or ongoing water quality studies and from land use, soil, hydrologic, and climatic data. This information will be needed to evaluate which practices will work given the local and regional conditions.

In cases where existing data are not adequate to identify or document a water quality problem, additional monitoring will be needed. The monitoring objective is to locate pollutant sources and ecological conditions contributing to the problem. The monitoring program must be designed such that at its conclusion a clear statement of the water use impairment(s), the primary pollutant(s), and the pollutant source(s) can be written.

After all pertinent preliminary water quality information has been obtained, and water quality data have been collected, a detailed water quality problem statement should be written. The water quality problem statement provides the basis for a strategy to effectively remediate or prevent water quality impairment and enhances the designated water resource use. The strategy is used to guide the selection and placement of practices designed to prevent, reduce, remediate, or retard specific pollutants. Clear problem identification and documentation should lead to a water quality problem statement that:

- Defines the water resource of concern;
- Delineates the water use impairment or threat of impairment and identifies its location and history; and
- States the pollutant(s), the pollutant source(s), and magnitude of the source(s).

Assumptions about the association between pollutants and impairments should be stated. In addition, any habitat attributes found to limit ecological health should also be included.

Water Quality Control Practices

Mechanisms to control existing or potential threats to water quality involve individual practices or systems of practices that address specific land uses, activities, pollutants, transport mechanisms, and/or management objectives.

Control practices use a variety of approaches that result in varying degrees of effectiveness. Practices can be temporary (e.g., for use during construction activity), permanent (e.g., detention pond) or managerial (e.g., record keeping).

Practices can be structural or nonstructural. Structural practices are manmade systems or devices designed to prevent or treat contamination. They may work by preventing leaks or water contamination, or stopping them at the source; collecting or diverting hazardous or toxic components of a waste stream; or encouraging filtration or infiltration of wastewater to allow natural processes to remove contaminants. Nonstructural practices work by changing behavior and may include such things as public education, land use controls, treatment requirements, and operating procedures.

Practices can be categorized as source controls or treatment controls, based on management objective. Source control is the first opportunity for control of any pollutant source. Source controls vary for different types of nonpoint source problems. They may or may not require construction. Examples of source controls include:

- Reducing or eliminating the introduction of pollutants to a land area. Examples include reduced nutrient and pesticide application.
- Preventing pollutants from leaving the site during land-disturbing activities. Examples include using conservation tillage, planning forest road construction to minimize erosion, siting marinas adjacent to deep waters to eliminate or minimize the need for dredging, and managing grazing to protect against overgrazing and the resulting increased soil erosion.
- Preventing interaction between precipitation and introduced pollutants. Examples include installing gutters and diversions to keep clean rainfall away from barnyards, diverting rainfall runoff from areas of land disturbance at construction sites, and timing chemical applications or logging activities based on weather forecasts or seasonal weather patterns.
- Protecting riparian habitat and other sensitive areas. Examples include protection and preservation of riparian zones, shorelines, wetlands, and highly erosive slopes.
- Protecting natural hydrology. Examples include pervious surface maintenance in developing areas (conditioned based on ground water considerations), riparian zone protection, and water management.

Treatment controls are practices for removing pollutants from contaminated runoff or wastewater before discharge. Treatment controls are generally structural in nature and do require maintenance. These practices intercept pollutants leaving the source prior to their delivery to the receiving water by capturing or infiltrating the runoff or wastewater, followed either by treating and releasing the effluent or by permanently keeping the effluent from reaching a surface water or ground water resource.

The performance of treatment controls is to a large extent dependent on suitable designs, operational conditions, and proper maintenance. For example, filter strips may be effective for controlling particulate and soluble pollutants where sedimentation is not excessive, but may be overwhelmed by high sediment input. Thus, in many cases, filter strips are used as pretreatment or supplemental treatment for other practices within a management system, rather than as an entire solution to a sedimentation problem.

Source controls are preferred over treatment controls for several reasons. Source controls are practices that prevent pollutants from entering a waterbody. Controlling pollutants at the source is more efficient and cost effective than removing them. In many situations, source controls can approach 100% effectiveness when implemented properly. Treatment control practices are rarely 100% effective, even if maintained and operated properly. There is also uncertainty as to the effectiveness and reliability of treatment control practices. Generally, source controls are less expensive than treatment controls and provide the most return for dollars invested.

The application of source and treatment control practices is dependent on site-specific conditions. Technical factors that may affect the suitability of management practices include, but are not limited to, land use, climate, size of drainage area, soil permeability, slopes, depth to water table, space requirements, type and condition of the water resource to be protected, depth to bedrock, and pollutants to be addressed.

There is often site-specific and regional variability in the selection of appropriate practices, as well as in the design constraints and pollution control effectiveness of practices. Factors to evaluate include the physical properties of the watershed (annual precipitation, soil type and drainage, ground water and surface water hydrology, and space limitations), land uses, and potential contaminants. Other criteria for determining what practice is best for a particular location might include the amount of pollution prevention or pollutant removal anticipated, the ease of implementing the practice, how much maintenance it will require, its longevity, the willingness of landowners to implement the practice (in a program of voluntary implementation, for instance), and its cost and cost-effectiveness. Practices must be economically feasible and well suited for the site.

When selecting practices, all costs must be considered, including labor and maintenance. Often a very effective practice will rapidly become a problem if all of the costs are not considered before implementation. The relative importance assigned to these and other criteria in judging what is best varies. Additionally, the choice of management practice is partially determined by the timeframe for the design, construction, and installation within the overall context of the associated activities.

Each structural and managerial practice used is part of a management practice system. Practices should be selected, designed, implemented, and maintained in accordance with site-specific considerations (e.g., slope, soil type, proximity to streams, and project layout) so they work effectively with the other management practices that form the system. This improves the ability of the practices to function together to achieve the overall management objectives. Final selection should be based upon the specific site conditions including land use activity, condition of receiving water, and types of pollutants present.

Examples of Best Management Practices (BMPs) Recently Implemented in the Field

The sections following each chapter of *Compendium of Best Management Practices to Control Polluted Runoff* showcase BMPs that were recently installed at field projects across Idaho. These projects, sponsored through DEQ's 319/Nonpoint Source Program are just a few of the many BMPs contained in this Compendium that may be applied to each of the seven sectors including:

Agricultural Practices (Table 1, pages 10-15),
Silviculture Practices (Table 2, pages 23-24),
Hydrologic Modification Practices (Table 3, pages 31-32),
Mining Practices (Table 4, Pages 37-39),
Urban Storm Water Practices (Table 5, pages 47-50),
Transportation Practices (Table 6, pages 57-59), and
Marina and Recreational Boating (Table 7, page 66)

Multi-Sector BMPs

Some BMPs related to roadways overlap into all seven sectors. These BMPs included actions like eradication of unneeded roadways, application of gravel to roadbeds, creation of truck friendly rolling water bars, and installation of fish friendly culverts. Other BMPs that can be used in any of the seven sectors include installation of properly sloped roadbeds, planting of grass, willows and dogwoods along waterways. Examples of BMPs are found at the end of each sector throughout the *Compendium*.

JERRY WEST, PHOTOGRAPHIC COMPILATION AUTHOR

Agricultural Activities

Agricultural runoff enters surface water through direct surface runoff or through seepage to ground water that discharge to a surface water outlet. The primary agricultural sources of pollutants are nutrients (particularly nitrogen and phosphorus), sediment, animal wastes, pesticides, and salts. Various farming activities result in the erosion of soil particles. The sediment produced by erosion can damage fish habitat and wetlands and, in addition, often transports excess agricultural chemicals resulting in contaminated runoff. This runoff in turn causes changes in aquatic habitats such as increased temperature and decreased oxygen. The most common sources of excess nutrients in surface water from polluted agricultural runoff are chemical fertilizers and manure from animal facilities. Such nutrients cause eutrophication in surface water. Pesticides used for pest control in agricultural operations can also contaminate surface as well as ground water resources. Return flows, runoff, and leachate from irrigated lands may transport sediment, nutrients, salts, and other materials. Finally, improper grazing practices in riparian and upland areas can also cause water quality degradation.

The land uses that comprise this sector include non-irrigated cropland, irrigated cropland, grazing land, animal waste management areas, and riparian/wetland areas. The practices that can be used to control agricultural pollutants control erosion and sediment, control discharges associated with animal facilities, manage nutrients and pesticides, control grazing impacts, and address water application on irrigated cropland.

Cropland, Non-irrigated and Irrigated

Activities associated with farming both non-irrigated and irrigated cropland can result in soil loss and the discharge of nutrients and pesticides. Practices to control polluted runoff from cropland can be used for both non-irrigated and irrigated cropland.

The problem associated with soil erosion is the movement of sediment and associated pollutants by runoff into a waterbody. Application of erosion and sediment control practices will reduce the mass load of sediment reaching a waterbody and improve water quality and the use of the water resource. Control can be achieved by using one of two different strategies or a combination of both. The first, and most desirable, strategy would be to implement practices on the field that would prevent erosion and the transport of sediment from the field. Practices that could be used to accomplish this are conservation tillage, contour strip-cropping, terraces, conservation cover, pasture planting and critical area planting.

The second strategy is to route runoff from fields through areas where control practices that remove sediment have been implemented. Practices that could be used to accomplish this are filter strips, field borders, grade stabilization structures, sediment retention ponds, water and sediment control

basins, and terraces. Site conditions will dictate the appropriate combination of practices for any given situation.

Nutrient management practices are used is to minimize edge-of-field delivery of nutrients and minimize leaching of nutrients from the root zone. Nutrient management is achieved by developing a nutrient budget for the crop, applying nutrients at the proper time, applying only the types and amounts of nutrients necessary to produce a crop, and considering the environmental hazards of the site. In cases where manure is used as a nutrient source, manure-holding areas may be needed to avoid application to frozen soil.

Pesticide management practices are used to reduce contamination of surface water and ground water from pesticides. The most effective approach to reducing pesticide pollution of waters is, first, to release fewer pesticides and/or less toxic pesticides into the environment and, second, to use practices that minimize the movement of pesticides to surface water and ground water. Integrated pest management strategies should be used to minimize the amount of pesticides applied. In addition, pesticides should be applied efficiently and at times when runoff losses are unlikely. When pesticide applications are necessary and a choice of materials exists, producers should choose the most environmentally benign pesticide products. Users must apply pesticides in accordance with the instructions on the label of each pesticide product.

There are also practices that can be used on irrigated cropland to reduce polluted runoff from irrigation. These practices address irrigation scheduling, efficient water application, and the control of tailwater. The efficient transport of irrigation water, the use of runoff or tailwater, and the management of drainage water are additional considerations.

The seepage losses associated with canals and laterals can be reduced by lining the canals and laterals, or can be eliminated by converting open canals and laterals to pipelines. Flow-through losses will not be changed by canal or lateral lining, but can be eliminated or greatly reduced by converting to pipelines.

Well-designed and managed irrigation systems remove runoff and leachate efficiently, control deep percolation, and minimize erosion from applied water, thereby reducing adverse impacts on surface water and ground water. Additional surface drainage structures such as filter strips, field drainage ditches, and subsurface drains may also be used to control runoff and leachate if site conditions warrant their use.

Grazing Land

The focus of grazing management practices is on the riparian zone, however, the control of erosion from range, pasture, and other grazing lands above the riparian zone is also encouraged. Application of these practices will reduce the physical disturbance to sensitive areas and reduce the discharge of sediment, animal waste, nutrients, and chemicals to surface waters.

For any grazing management system to work, it must be tailored to fit the needs of the vegetation, terrain, class or kind of livestock, and particular operation involved. For both pasture and range, areas should be provided for livestock watering, salting, and shade that are located away from streambanks and riparian zones where necessary and practical. This can be accomplished by managing livestock grazing and providing facilities for water, salt, and shade as needed.

Appropriate grazing management systems ensure proper grazing use by adjusting grazing intensity and duration to reflect the availability of forage and feed designated for livestock uses and by controlling animal movement through the operating unit of range or pasture. Proper grazing use will maintain enough live vegetation and litter cover to protect the soil from erosion; will achieve riparian and other resource objectives; and will maintain or improve the quality, quantity, and age distribution of desirable vegetation. It may be necessary to improve or reestablish the vegetative cover on range and pastures to reduce erosion rates.

Providing water and salt supplement facilities away from streams will help keep livestock away from streambanks and riparian zones. The establishment of alternate water supplies for livestock is an essential component when problems related to the distribution of livestock occur in a grazing unit. Using the

stream crossing technology to build a watering site can provide access to a developed or natural water supply that is protective of streambank and riparian zones. In some locations, artificial shade may be constructed to encourage use of upland sites for shading and loafing.

It may be necessary to minimize livestock access to streambanks, ponds, lakeshores, and riparian zones to protect these areas from physical disturbance. Fencing or establishing special use pastures to manage livestock in areas of concentration could also accomplish this.

Animal Waste

The problems associated with animal facilities result from runoff, facility wastewater, and manure. Practices that address these problems divert runoff water from upslope sites and roofs away from the facility, thereby minimizing the amount of water to be stored and managed. Runoff water and facility wastewater should be routed through a settling structure or debris basin to remove solids, and then stored in a pit, pond, or lagoon for application on agricultural land. For new facilities and expansions to existing facilities, consideration should be given to siting the facility away from surface waters, away from areas with high leaching potential, and in areas where adequate land is available to apply animal wastes in accordance with the nutrient management measure.

Animal waste practices also address the management of runoff from manure storage areas. Manure may be stacked in a confined lot or other appropriate area as long as runoff from the confined lot is controlled. If manure is managed as a solid, any drainage from the storage area, structure area, or structure should be routed to the runoff storage system. When applied to agricultural lands, manure, stored runoff water, stored facility wastewater, and accumulated solids from the facility should be applied in accordance with nutrient management practices.

It is recognized that implementation of this measure may increase the potential for movement of water and soluble pollutants through the soil profile to the ground water. Facility wastewater and runoff control systems can and should be designed to protect ground water. If soil conditions require further protection of ground water, protection can also be provided by minimizing seepage to ground water and by using the nutrient and pesticide management practices to reduce and control the application of nutrients and pesticides.

Riparian/Wetland Areas

Agricultural land use activities have the potential to degrade riparian habitats and wetlands. Livestock grazing is a significant contributor to streambank erosion and riparian habitat degradation. Problems associated with grazing included reduced riparian cover, exposed streambanks, high sediment levels, elevated water temperatures, higher nutrient levels, and a shifting to more stress-tolerant invertebrates.

Upland grazing management practices discussed above will protect water quality and aquatic and riparian habitats. Another practice that specifically protects riparian areas and wetlands is excluding livestock from sensitive areas such as streambanks, wetlands, estuaries, ponds, lakeshores, soils prone to erosion, and riparian zones. When exclusion is not practicable, livestock access can be minimized though the use of improved grazing management systems, installing alternative drinking water sources, installing hardened access points for drinking water consumption, and providing stream crossings.

Land and streambank stabilization practices can be used when damage to a wetland or riparian has already occurred. It may be necessary to improve or reestablish the vegetative cover on range and pastures or on streambanks to reduce erosion rates. Other practices such as planting channel vegetation, stabilizing stream channels and restoring wetlands can be employed when livestock has impacted a stream channel or wetland.

TABLE 1. Agricultural Practices

PRACTICE (NRCS Practice Code) *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
NONIRRIGATED CROPLAND													
Alley Cropping (311)	N, S							✓			✓		
Contour Buffer Strips (332)	N, S						✓				✓		
Conservation Cover ((327)	N, S						✓	✓					
Conservation Crop Rotation (328)	N, S					✓							
Contour Farming (330)	N, S					✓							
Cover and Green Manure Crop (340)	N, S						✓						
Critical Area Planting (342)	N, S						✓						
Deep Tillage (324)	N, S												
Field Border (386)	N, S						✓						
Field Windbreak (380)	N, S						✓						
Filter Strip (393)	N, S										✓		
Grassed Waterway (412)	N, S							✓					
Mulching (484)	N, S						✓						
PAM Erosion Control (450)	N, S						✓	✓		✓			
Pasture and Hayland Planting (512)	N, S	✓											
Residue Management (329)	N, S						✓						
Sediment Basin (350)	N, S												✓
Stripcropping, Contour (585)	N, S					✓							
Stripcropping, Field (586)	N, S					✓							

continued

PRACTICE (NRCS Practice Code) *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Nonirrigated Cropland (continued)													
Subsurface Drain (606)	N, S			✓									
Subsurface Drainage, Field Ditch (607)	N, S			✓									
Subsurface Drainage, Main or Lateral (608)	N, S			✓									
Surface Roughening (609)	N, S					✓		✓					
Terrace (600)	N, S					✓							
Underground Outlet (620)	N, S			✓									
Water and Sediment Control Basin (638)	N, S												✓
IRRIGATED CROPLAND													
Irrigation Canal or Lateral (320)	N, S			✓		✓							
Irrigation Field Ditch (388)	N, S			✓		✓							
Irrigation Land Leveling (464)	N, S			✓									
Irrigation Pit or Regulating Reservoir (552)	N, S				✓								
Irrigation Storage Reservoir (436)	N, S					✓							
Irrigation System, Sprinkler (442)	N, S					✓							
Irrigation System, Surface or Subsurface (443)	N, S					✓							

continued

PRACTICE (NRCS Practice Code) *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Irrigated Cropland (continued)													
Irrigation System, Tailwater Recovery (447)	N, S				✓								
Irrigation System, Microirrigation (441)						✓							
Irrigation Water Conveyance (428)	N, S				✓								
Irrigation Water Management (449)	N, S	✓											
Land Smoothing (466)	N, S					✓							
Lined Waterway or Outlet (468)	N, S			✓									
GRAZING LAND													
Brush Mgmt (314)	S							✓					
Channel Vegetation (322)	S, TP							✓					
Fencing (382)	S						✓						
Firebreak (394)	S						✓						
Forage Harvest Management (511)	S	✓											
Grazing Land Mechanical Treatment (548)	S					✓							
Heavy Use Area Protection (561)	B, N, S						✓						
Pipeline (516)	B, N, S			✓									
Prescribed Grazing (528)	B, N, S	✓											
Range Seeding (550)	B, N, S							✓					

continued

PRACTICE (NRCS Practice Code) *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Grazing Land (continued)														
Spring Development (574)	B, N, S						✓						
Stock Trails and Walkways (575)	B, N, S					✓							
Streambank and Shoreline Protection (580)	N, S						✓						
Use Exclusion (472)	B, N, S						✓						
Water Harvesting Catchment (636)	B, N, S						✓						
Watering Facility (614)	B, N, S				✓		✓						
Closure of Waste Impoundments (360)	B, N				✓	✓		✓					
Composting Facility (317)	B, N					✓		✓	✓				
Dike (356)	B, N				✓								
Manure Transfer (634)	B, N			✓									
Roof Runoff Structure (558)	B, N					✓							
Waste Storage Facility (313)	B, N				✓								
Waste Treatment Lagoon (359)	B, N								✓				
Waste Utilization (633)	B, N					✓							
RIPARIAN/WETLAND AREAS														
Constructed Wetland (656)									✓		✓		✓
Fish Passage (396)														

continued

PRACTICE (NRCS Practice Code) *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Riparian/Wetland Areas (continued)													
Riparian Forest Buffer (391)	B, N, S, TP										✓		
Stream Channel Stabilization (584)	S							✓					
Stream Habitat Improvement and Management (395)	B, N, S, TP												
Tree/Shrub Establishment (612)	B, N, S, TP							✓					
Upland Wildlife Habitat Management (645)													
Wetland Restoration (657)													
Wetland Wildlife Habitat Management (644)													
GENERAL PRACTICES													
Access Road (560)							✓	✓					
Dam, Diversion (348)													
Diversion (362)	S			✓									
Grade Stabilization Structure (410)	S							✓					
Nutrient Management (590)	N	✓											
Pest Management (595)	T	✓											
Pond (378)													
Pond Sealing and Lining (521)					✓								

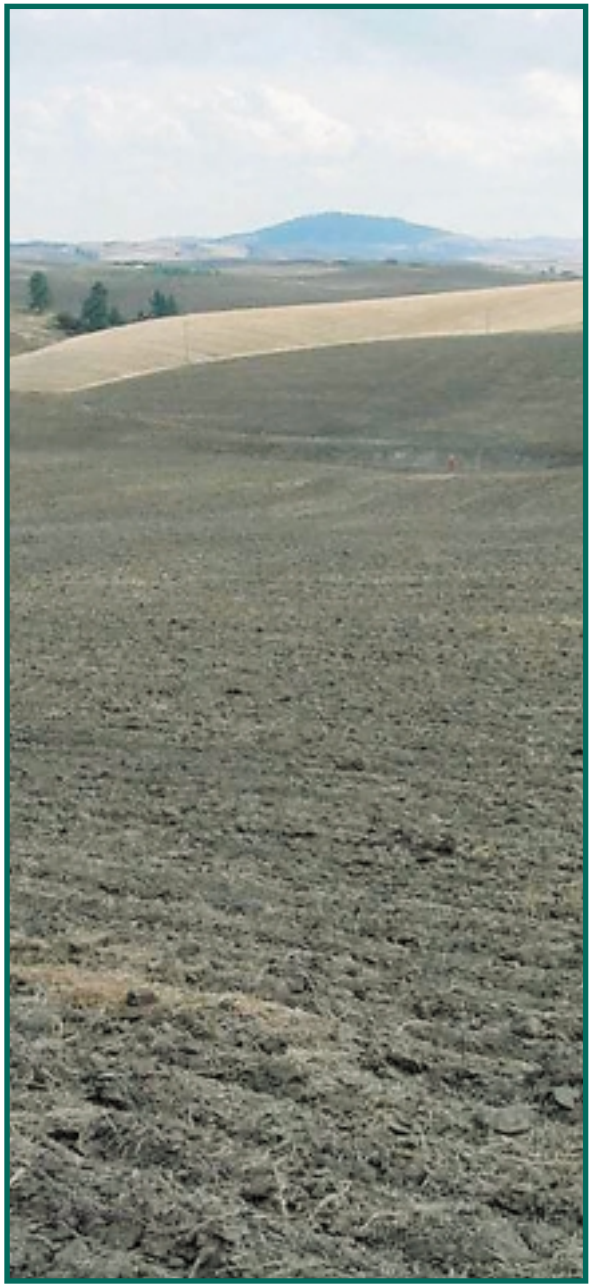
continued

PRACTICE (NRCS Practice Code) *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
General Practices (continued)													
Prescribed Burning (338)	N, S	✓											
Pumping Plant for Water Control (533)	NA			✓									
Spoil Spreading (572)	S							✓					
Structure for Water Control (587)	NA			✓									
Water Well (642)													
Well Decommissioning (351)					✓								

AGRICULTURE SECTOR BMPS

Agriculture is the single largest nonpoint source contributor of sediment and nutrients to Idaho's surface water. Accordingly, there are numerous BMPs that are used almost exclusively for reduction of agricultural-related pollution. Some agriculture-related BMPs require education and close cooperation among farmers, ranchers, and numerous federal, state, and nonprofit organizations for implementation.

This sediment filter strip buffer has been graded in preparation for seeding. Previously, local farmers deep-tilled the land and planted wheat right up to the county road borrow ditch. This practice results in tons of sediment and nutrients being eroded, conveyed along the borrow ditch to tributaries and ultimately deposited into Winchester Lake. Once established (see photo on next page), this permanent grassy barrier will greatly reduce the amount of contaminants being transported to the lake.



▶ *In addition to the permanent filter strip buffers along highways, many farmers in Winchester Lake drainage area have agreed to start using no-till-farming techniques. At first glance this field might look like any other tilled field with furrows six to eight inches deep. But in reality this land has furrows that are only one to two inches deep. The net result is that the farmer saves time and fuel, production is increased, and there is much less erosion resulting in preservation of topsoil.*

▶ *This photo shows a small section of filter strip (foreground) buffering hundreds of acres of land that has been no-till farmed. These two BMPs result in greatly reduced erosion of sediment and nutrients into nearby Winchester Lake.*


NO MOTORIZED VEHICLES
OF ANY TYPE ALLOWED
PAST ROCK BARRIERS
FOR PUBLIC SAFETY AND
ENVIRONMENTAL RESTORATION

Silviculture Activities

Without adequate controls, silviculture operations may degrade waterbodies receiving runoff from forestlands. Sediment concentrations can increase due to accelerated erosion; water temperatures can increase due to removal of overstory riparian shade; slash and other organic debris can accumulate in waterbodies, depleting dissolved oxygen; and organic and inorganic chemical concentrations can increase due to harvesting, applying fertilizers and pesticides and oil and grease from equipment maintenance and operation. These potential increases in water quality contaminants are usually proportional to the severity of site disturbance.

The major silviculture activities that comprise this sector include timber harvest, road construction and management, forest regeneration, fire management, and chemical management.

Timber Harvest

Preplanning the timber harvest operation to ensure water quality protection can minimize polluted runoff and increase operation efficiency. Preharvest planning should include provisions to identify areas that may have merchantable trees, but pose unacceptable risks for landslides or high erosion hazard. Potential water quality and habitat impacts should also be considered when planning the harvest systems (even-aged versus uneven-aged) and planning the type of yarding system. Preharvest planning should address how harvested areas will be replanted or regenerated to prevent erosion and potential impact to waterbodies.

The planning of the streamside management area (SMA) width and extent is also crucial because of SMAs potential to reduce pollutant delivery. Careful planning of road and skid trail system locations will reduce the amount of land disturbance by minimizing the area of roads and trails, thereby reducing erosion and sedimentation. The proper design of drainage systems and stream crossings can prevent system destruction by storms, thereby preventing severe erosion, sedimentation, and channel scouring.

Streamside management areas are widely recognized to be highly beneficial to water quality and aquatic habitat. Streamside management areas need to be of sufficient width to prevent delivery of sediments and nutrients generated from forestry activities (harvest, site preparation, or roads) in upland areas to the waterbody being protected. Streamside management areas should be managed to maintain a sufficient number of large trees to provide for bank stability and a sustainable source of large woody debris. A sufficient number of canopy species should also be maintained to provide shading to the stream water surface needed to prevent changes in the temperature regime in the waterbody and to prevent deleterious temperature- or sunlight-related impacts on the aquatic biota.

The goal of planning practices and streamside management is to minimize sedimentation resulting from the siting and operation of timber harvesting and to manage petroleum products properly. Locating landings for both groundskidding and cable yarding harvesting systems according to preharvest planning minimizes erosion and sediment delivery to surface waters. Final siting of landings may need to be adjusted in the field based on site characteristics.

Ground skidding practices include skidding logs uphill to log landings whenever possible. Skid with ends of logs raised to reduce rutting and gouging. Skid along the contour and avoid skidding on slopes greater than 40 percent. Suspend ground skidding during wet periods, when excessive rutting and churning of the soil begins, or when runoff from skid trails is turbid and no longer infiltrates within a short distance from the skid trail. Retire skid trails by installing water bars or other erosion control and drainage devices, removing culverts and revegetating.

Landings and loading decks can become very compacted and are therefore a source of runoff and erosion. Practices that prevent or disperse runoff from these areas before the runoff reaches watercourses will minimize sediment delivery to surface waters. Proper closure of skid trails and landings will eliminate erosion in these areas. Practices can include water bars, scarification, seeding and/or obliteration.

Any chemicals or petroleum products spilled in harvest areas can be highly mobile, adversely affecting the water quality of nearby surface waters. Correct spill prevention and containment procedures are necessary to prevent petroleum products from entering surface waters. Designation of appropriate areas for petroleum storage will also minimize water quality impacts due to spills or leakage.

Road Construction and Management

Disturbance of soil and rock during road construction/reconstruction creates a significant potential for erosion and sedimentation of nearby streams and lakes. Proper road design and construction that are tailored to the topography and soils and that take into consideration the overall drainage pattern in the watershed can prevent road-related water quality problems. Road fill and road backslope failure, which can result in mass movements and severe sedimentation, can also be prevented.

Stabilizing back slopes and fill slopes as they are constructed is an important process in minimizing erosion from these areas. Combined with graveling or otherwise surfacing the road, establishing grass or using another form of slope stabilization can significantly reduce soil loss from road construction.

Proper road drainage prevents the concentration of water on road surfaces, thereby preventing road saturation that can lead to rutting, road slumping, and channel washout. It is especially important to ensure that road drainage structures are well constructed and designed for use during logging operations because the heavy vehicle use during harvesting creates a high potential for the contribution of large quantities of sediment to runoff.

The composition of a road surface is another factor that can be controlled to effectively control erosion from the road surface and slopes. Road surfaces can be formed from native material, aggregates, asphalt or other suitable materials and any of these surface compositions can be shaped with crowns, inslopes, and outslopes to promote drainage.

Sound planning, design, and construction practices often reduce the future levels of necessary road maintenance. Roads constructed with a minimum width in stable terrain, and with frequent grade reversals or dips, require minimum maintenance. Drainage of the road prism, road fills in stream channels, and road fills on steep slopes are the elements of greatest concern in road management. Roads used for active timber hauling usually require the most maintenance, and mainline roads typically require more maintenance than spur roads. The use of roads during wet or thaw periods can result in badly rutted surfaces, impaired drainage, and excessive sediment reaching waterbodies.

Inactive roads not being used for timber hauling are often overlooked and receive little maintenance. Older roads remain one of the greatest sources of sediment from forestland

management. In some locations, problems associated with altered surface drainage and diversion of water from natural channels can result in serious gully erosion or landslides. Erosion problems may go unnoticed until after there is severe resource damage.

For these situations, there are road management controls that address maintenance of the roads and associated drainage systems. They also include provisions for road closure. Road closure involves preventing access by placing gates or other obstructions at road access points while maintaining the road for future use. Roads that will no longer be used or that have remained unused for many years may be decommissioned and obliterated. Decommissioning typically involves stabilizing fills, removing stream crossings and culverts, recontouring slopes, reestablishing original drainage patters, and revegetating disturbed areas.

Forest Regeneration

Regeneration of harvested forestlands not only is important in terms of restocking a valuable resource, but also is important to provide water quality protection from disturbed soils. Tree roots stabilize disturbed soils by holding the soil in place and aiding soil aggregation, which decreases slope failure potential. The presence of vegetation on disturbed soils also slows storm runoff, which in turn decreases erosion.

Leaving the forest floor litter layer intact during site preparation operations for regeneration minimizes mineral soil disturbance and detachment, thereby minimizing erosion and sedimentation. Mechanical site preparation can potentially impact water quality in areas that have steep slopes and erodible soils and in areas where the prepared site is located near a waterbody. Use of mechanical site preparation treatments that expose mineral soils on steep slopes can greatly increase erosion and landslide potential. Alternative methods, such as drum chopping, herbicide application, or prescribed burning, disturb the soil surface less than mechanical practices.

Mechanical planting using machines that scrape or plow the soil surface can produce erosion rills, which increase surface runoff and erosion. Natural regeneration, hand planting, and direct seeding are methods that can be used to minimize soil disturbance, especially on steep slopes with erodible soils.

Revegetation of areas of disturbed soil can successfully prevent sediment and pollutants associated with the sediment (such as phosphorus and nitrogen) from entering nearby surface waters. The vegetation controls soil erosion by dissipating the erosive forces of raindrops, reducing the velocity of surface runoff, stabilizing soil particles with roots, and contributing organic matter to the soil, which increases soil infiltration rates.

Fire Management

Fire management practices address prescribed fire for site preparation and stand maintenance as well as activities associated with wildfire control or suppression. Prescribed burning reduces slash, competition for nutrients among seedlings, and fuel for wildfires. Where tree species are ecologically dependent on fire for regeneration, fire also serves as an essential forest management tool. Prescribed burning must be properly managed to reduce soil disturbance during preparation for the burn and to limit the severity of the burn.

Wildfire suppression practices include avoiding of the use of fire-retardant chemicals over watercourses and remediating burned areas as soon as possible after the emergency is controlled. Other control practices include the proper location, design and closure of fire suppression components such as firelines, staging areas, helispots and camps.

Chemical Management

Chemicals used in forest management are generally pesticides (insecticides, herbicides, and fungicides) and fertilizers. Since pesticides may be toxic, they must be mixed, transported, loaded, and applied properly and their containers disposed of properly according to label restrictions in order to prevent potential polluted runoff. Since fertilizers may also be toxic or may shift the ecosystem energy dynamics, depending on the exposure and

concentration, they must also be properly handled and applied. Oil, grease and antifreeze used for vehicle maintenance should also be stored, handled and disposed of properly.

Pesticides and fertilizers can pose a risk to the aquatic environment depending on the application technique used. These chemicals can directly enter surface waters through five major pathways: direct application, drift, mobilization in ephemeral streams, overland flow, and leaching. The input from direct application is the most important source of increased chemical concentrations and is also one of the most easily prevented through proper application.

TABLE 2. Silviculture Practices

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
TIMBER HARVEST													
Harvest Planning	S	✓											
Road System Planning	S	✓											
Preharvest Notification	S	✓											
Streamside Management Areas	S, N, TP	✓											
Harvesting Practices	S					✓							
Landing Practices	S					✓							
Ground Skidding Practices	S					✓							
Cable Yarding Practices	S					✓							
Soil Protection	S						✓						
Winter Harvesting	S					✓	✓						
Petroleum Management	H	✓											
Waste Materials Treatment	S		✓										
ROAD CONSTRUCTION AND MANAGEMENT													
Scheduling	S	✓											
Soil Stabilization	S							✓					
Revegetation of Disturbed Areas	S							✓					
Runoff Collection and Conveyance	S			✓									
Runoff Dispersion and Dissipation	S					✓							
Sediment Collection	S												✓
Stream Crossings	S						✓						

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Road Construction and Management (continued)													
Road Maintenance	S					✓							
Drainage Structure Maintenance	S					✓							
Access Restriction	S						✓						
Revegetation	S							✓					
Winter Operation	S						✓						
Inactive Roads	S							✓					
Long-Term Inactive Roads	S							✓					
Permanent Road Closure	S							✓					
FOREST REGENERATION													
Site Preparation Practices	S						✓						
Residual Stocking	S						✓						
Regeneration Practices	S							✓					
Revegetation of Disturbed Areas	S							✓					
FIRE MANAGEMENT													
Prescribed Fire Practices	S, N						✓						
Wildfire Practices	S, N					✓	✓						
Fireline Practices	S, N					✓							
FOREST CHEMICAL MANAGEMENT													
Leak/Spill Prevention	H, T	✓											
Spill Contingency Plan	H, T				✓								

At the *Cascade Reservoir Watershed Roads and Forested Lands Project* located east and west of Cascade Reservoir, Valley County, Idaho the U S Forest Service, BLM, Idaho Department of Parks and Recreation and the Boise Cascade Corporation joined efforts to install a variety of BMPs. The project greatly reduces logging road sediment to 8.7 miles of road segments identified in the Cascade Reservoir TMDL. This is a high priority area in the forestry portion of the plan. Applications of these BMPs may be found in Tables 1, 2, 3, 4 and 6 of the Compendium. These BMPs include construction of logging truck (and other large vehicle) friendly rolling water bars, application of gravel, carefully sloped roadbeds, and eradication of unneeded roadways that contribute sediment to streams (photos on pages 25 and 26).

◀ *Prior to roadwork the 150-foot section of road shown in this photo contributed tons of sediment to Gold Fork Creek annually. This section of road was re-sloped, rolling water bars installed, and angular gravel applied. The bathtub was installed as a simple means of monitoring annual sediment runoff.*

▶ *The lower photo shows the annual total amount of sediment (less than one inch in depth) that was transported from the 150-foot section of road after the BMPs were installed.*

◄ *This is an example of a previous recreational road that was closed because it was a source of sediment erosion into Gold Fork Creek — a tributary to Cascade Reservoir. People now walk along this section of Gold Fork Creek but can no longer drive vehicles there. Applications of this BMP may be found in Tables 2, 3, 4, 6, and 7 of the Compendium.*

Hydrologic and Habitat Modification Activities

Hydromodification activities have been separated into the categories of channelization and channel modification, dams, and streambank and shoreline erosion. These categories include a wide variety of activities that impact instream and riparian habitat, wetlands, and streambanks.

One form of hydromodification is channel modification, which is river and stream channel engineering undertaken for the purpose of flood control, navigation, drainage improvement, and reduction of channel migration potential. Activities such as straightening, widening, deepening, or relocating existing stream channels and clearing or snagging operations fall into this category. These forms of hydromodification typically result in more uniform channel cross-sections, steeper stream gradients, and reduced average pool depths.

A frequent result of channel modification activities is a diminished suitability of instream and streamside habitat for fish and wildlife. They can also alter instream patterns of water temperature and sediment type, as well as the rates and paths of sediment erosion, transport, and deposition. Excavation projects can result in reduced flushing, lowered dissolved oxygen levels, loss of streamside vegetation, accelerated discharge of pollutants, and changed physical and chemical characteristics of bottom sediments in surface waters surrounding channelization or channel modification projects.

The term flow alteration describes a category of hydromodification activities that result in either an increase or a decrease in the usual supply of fresh water to a stream, river, or estuary. Flow alteration activities and structures include diversions, withdrawals, and impoundments. In rivers and streams, flow alteration can also result from undersized culverts, transportation embankments, sluice gates, and weirs.

Dams can adversely impact the hydraulic regime, the quality of the surface waters, and habitat in the stream or river where they are located. A variety of impacts can result from the siting, construction, and operation of dams. The siting of dams can result in the inundation of wetlands, riparian areas, and dry land upstream of the waterway. Dams either reduce or eliminate the downstream flooding needed by some wetlands and riparian areas. Dams can also impede or block migration routes of fish. Construction activities from dams can cause increased turbidity and sedimentation in the waterway resulting from vegetation removal, soil disturbance, and soil rutting.

The operation of dams can also generate a variety of types of pollution in surface waters. Dam operations may lead to reduced downstream flushing, which, in turn, may lead to increased loads of biological oxygen demand, phosphorus, and nitrogen; changes in pH; and the potential for increased algal growth. Lower instream flows, and lower peak flows associated with controlled releases from dams, can result in sediment deposition in the channel several miles downstream of the dam. The tendency of dam releases to be clear

water, or water without sediment, can result in erosion of the streambed and scouring of the channel below the dam, especially the smaller-sized sediments. Finally, reservoir releases can alter the water temperature and lower the dissolved oxygen levels in downstream portions of the waterway.

Streambank erosion is a natural process that occurs in all fluvial systems, typically on large time scales. Streambank erosion can also be induced or exaggerated by human activities. Numerous factors within the watershed can contribute to anthropogenic streambank erosion in a given location. Three major causes of accelerated erosion related to human activity are channel modification, reservoir construction, and land use changes. Excessively high sediment loads that can result from streambank erosion can smother submerged aquatic vegetation beds, fill in riffle pools, and contribute to increased levels of turbidity and nutrients.

Channel Modification

Properly evaluating potential projects and reevaluating existing projects to ensure they reduce polluted runoff impacts and maximize potential benefits can help reduce impacts. Proper evaluation of channelization and channel modification projects should include examining existing and potential conditions and watershed management.

Existing channel modification projects can be evaluated to determine the impacts and benefits associated with the projects. Modifications to existing projects, including operation and maintenance or management activities, can also be evaluated to determine the possibility of improving some or all of the impacts without reducing the existing benefits or creating additional problems.

New channel modification projects that cause unavoidable physical or chemical changes in surface waters can also use one or more practices to mitigate the undesirable changes. The practices include streambank protection, levee protection, channel stabilization, flow restrictors, check dam systems, grade control structures, vegetative cover, instream sediment control, and setback levees or flood walls. By using one or more of these practices in combination with predictive modeling and restricting the timing of the activity, the adverse impacts of channelization and channel modification projects can be evaluated and possibly corrected.

Several structural practices are used in the protection or rehabilitation of eroded banks. These practices are usually implemented in combination to stabilize the stream system, and they can be grouped into direct and indirect methods. Direct methods place protective material in contact with the bank to shield it from erosion. Indirect methods function by deflecting channel flows away from the bank or by reducing the flow velocities to nonerosive levels.

Direct methods for streambank protection include stone riprap revetment, erosion control fabrics and mats, revegetation, burlap sacks, cellular concrete blocks, and bulkheads. Indirect methods include:

- Using dikes, wire or board fences, gabions, and stone longitudinal dikes
- Using hydraulic structures to stabilize stream channels, and to control stream sediment load and transport
- Using check dam systems, which provide sediment-reduction functions by trapping sediment behind the dams
- Using grade control structures, hydraulic barriers (weirs) installed across streams to stabilize the channel, control headcuts and scour holes, and prevent upstream degradation
- Planting vegetative cover alone or in combination with other structural practices.

There are several structural practices that can be used to control instream sediment depending on the management objective and the source of sediment. Streambank protection and channel stabilization practices, including various types of revetments, grade control structures, and flow restrictors, have been effective in controlling sediment production caused by streambank erosion.

Dams

Best management practices for dams should be undertaken individually or in combination to improve water quality and aquatic and riparian habitat in reservoir impoundments and tailwaters. They include:

- Using pumping and injection systems for reservoir aeration,
- Adjusting operational procedures at dams,
- Restoring or maintaining aquatic and riparian habitat, and
- Evaluating and managing the watershed.

One general type of pumping and injection systems uses pumps, air diffusers, or airlifts to induce circulation and mixing of layers of water. Another approach to improving water quality in tailwaters is aeration of reservoir releases through turbine venting, injection of air into turbine releases, installation of re-regulation weirs, use of selective withdrawal structures, or modification of other turbine start-up or pulsing procedures. A third group of approaches includes engineering modifications to the intakes, the spillway, or the tailrace, or the installation of various types of weirs downstream of the dam to improve temperature or dissolved oxygen levels in tailwaters. These practices rely on agitation and turbulence to mix the reservoir releases with atmospheric air in order to increase the concentrations of dissolved oxygen.

The quality of reservoir releases can also be improved through adjustments in the operational procedures at dams. These include scheduling releases or shortening the duration of shutoff periods, instituting procedures for the maintenance of minimum flows, and making seasonal adjustments in the pool levels and in the timing and variation of the rate of drawdown.

Several options are available for the restoration or maintenance of aquatic and riparian habitat in the area of a reservoir impoundment or in portions of the waterway downstream from a dam. One set of practices is designed to augment existing flows that result from normal operation of the dam. These include operation of the facility to produce flushing flows, minimum flows, or turbine pulsing. Another approach to producing minimum flows is to install small turbines that operate continuously. Installation of reregulation weirs in the waterway downstream from the dam can also achieve minimum flows. Finally, riparian improvements restore or maintain aquatic and riparian habitat in portions of the waterway affected by the location and operation of a dam.

Watershed management is also a valuable tool to reduce water quality problems in reservoirs and dam releases. Most polluted runoff problems in reservoirs and dam tailwaters frequently result from pollutants in the contributing watershed (e.g., sediment, nutrients, metals, and toxics). Good practices for watershed management include land use planning, erosion control, ground water protection, mine reclamation, pollutant source screening and identification, animal waste control, and failing septic tank control.

Another general watershed management practice involves the evaluation of the total watershed. This practice involves the evaluation of the sources of pollution in a watershed and determination of the most cost-effective combination of practices to reduce pollution among the various point and nonpoint sources.

Shoreline and Streambank Stabilization

Preservation and protection of shorelines and streambanks can be accomplished through many approaches, but nonstructural practices, such as soil vegetative bank stabilization ("bioengineering") and wetland creation are preferred. Other practices include structural practices, no-wake zones, and setbacks. Techniques involving wetland creation and bioengineering will usually be effective at sites with limited exposure to wave action. In other cases, the use of engineering approaches may need to be considered. In addition to controlling sediment sources that are causing pollution, these techniques can halt the destruction of wetlands and riparian areas located along the shorelines of surface waters. Once these features are protected, they can serve as a filter for surface water runoff from upland areas, or as a sink for nutrients, contaminants, or sediment already present in surface waters.

Bioengineering refers to the installation of living plant material as a main structural component in controlling problems of land instability where erosion and sedimentation are occurring. Soil bioengineering provides an array of practices that are effective for both prevention and mitigation of polluted runoff problems.

Wetland creation and restoration is another useful vegetative technique that can be used to address problems with erosion of shorelines. Wetland plants perform two functions in controlling shore erosion: dissipation of wave energy and added stability. The basic approach to erosion control is to plant a shoreline area with appropriate plant species.

Properly designed and constructed shore and streambank erosion control structures are used in areas where higher wave energy makes biostabilization and wetland creation ineffective. The most widely accepted alternative engineering practices for streambank or shoreline erosion control are fixed engineering structures, revetments, gabions, and groins. In areas where existing protection methods are being flanked or are failing, structural shore erosion control methods such as returns or return walls, toe protection, and proper maintenance or total replacements should be implemented. All streambank, shoreline, and navigation structures should be implemented so that they do not transfer erosion energy or otherwise cause visible loss of surrounding streambanks or shorelines.

No-wake zones can be established and enforced to reduce erosion potential from boat wakes. No-wake zones should be given preference over posted speed limits for reducing the erosion potential of boat wakes on streambanks and shorelines.

Another approach that should be considered in the planning process for shoreline and streambank erosion involves the designation of setbacks. Setbacks most often take the form of restrictions on the siting and construction of new standing structures along the shoreline. Upland drainage from development should be directed away from bluffs and banks so as to avoid accelerating slope erosion.

TABLE 3. Hydrologic Modification Practices

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
HYDROMODIFICATION													
Streambank Protection	S						✓						
Levee Protection	S						✓						
Channel Stabilization	S							✓					
Flow Restrictors	S					✓							
Check Dam Systems	S							✓					
Drop Structure, Sills and Barbs	S							✓					
Grade Stabilization Structures	S							✓					
Vegetative Cover	S, TP						✓	✓					
Instream Sediment Control	S							✓					
Levee or Floodwall Setbacks	S						✓						
Restrict Timing of Activity		✓					✓						
DAMS													
Reservoir Aeration Sluicing Turbine Pulsing Turbine Venting Reregulation Weir	DO	✓											
Operational Adjustments	DO	✓					✓	✓					
Habitat Restoration and Maintenance (aquatic and riparian)	S, TP												
Flow Adjustments	DO	✓											

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Dams (continued)														
Small Turbines	DO					✓								
Watershed Practices	All	Practice dependent												
SHORELINE AND STREAMBANK STABILIZATION														
Bioengineering	S							✓						
Constructed Wetlands	N, S								✓		✓		✓	
Dikes	S				✓		✓							
Structural Stabilization Practices	S							✓						
No-Wake Zones	S						✓							
Setbacks	N, S						✓							

At the *Winchester Lake & Upper Lapwai Creek Watershed Project* located near Grangeville, Idaho the Lewiston Soil and Water Conservation District, Nez Perce Tribe and Idaho Fish and Game worked together to install a variety of BMPS. Applications of this BMP may be found in all seven sectors (Tables 1-7).

◄ *This is an example of one of many new fish friendly culverts recently installed on tributaries to Winchester Lake.*

This photo shows grass, willows, and dogwoods that have been planted along an intermittent watercourse that drains into Winchester Lake. This new vegetation is greatly reducing the amount of sediment, nitrogen and phosphorous deposited in Winchester Lake. Applications of this BMP may be found in Tables 1, 2, 3, 4, 5 and 6 of the Compendium.

Mining Activities

Mining activities and inactive mine sites can generate a variety of pollutants, including some of the most environmentally detrimental compounds of any discharging activity. Sources can be divided into those requiring sediment and erosion controls (largely the active mining process), active and inactive sites that produce acid mine drainage, which requires more involved treatment, and inactive mine sites that require reclamation.

Sediment and Erosion Control

Successful control of erosion and sedimentation from active mining should involve a system of practices that targets each stage of the erosion process. The most efficient approach involves minimizing the potential sources of sediment from the outset. This first step involves limiting the extent and duration of land disturbance to the minimum needed, and protecting surfaces once they are exposed. The second step involves controlling the amount of runoff and its ability to carry sediment by diverting incoming flows and impeding internally generated flows. The third step involves retaining sediment that is picked up on the project site through the use of sediment-capturing devices. On most sites successful erosion and sedimentation control requires a combination of structural and vegetative practices. All of these steps are better performed using advance planning and good scheduling.

General mining practices to reduce erosion and sedimentation include:

- Diverting storm water runoff away from the storage piles and active faces;
- Keeping the site clean at all times to reduce storm water contamination and loading;
- Segregating, re-grading and re-vegetating overburden to minimize erosion;
- Using ditches and dikes to control and divert runoff and reduce velocities; and
- Diverting all runoff through infiltration ponds and extended detention wet ponds or even artificial wetlands to remove suspended sediments.

Potential impacts from mining begin in the exploration phase. Practices to offset these impacts include restoring the site, minimizing and decommissioning access tracks, and rehabilitating the land when finished. Other practices include preventing leaks and spills, providing lined sumps or tanks to contain drilling fluids, and casing drill holes that penetrate several aquifers of variable quality water to prevent cross contamination.

Impacts from access and haul roads should also be addressed. Good practices should address location and design, road construction, and maintenance and closure. Additional information about road practices can be found in the silviculture section.

Good housekeeping practices should also be used for other site activities. They include such things as using grades, ditches, and dikes to collect and reuse wash water; wetting roads and traveled surfaces to reduce dust; and using an impervious surface, grades, and ditches or berms to keep fuel and oil from maintenance areas from contaminating the

ground or storm water. Raising maintenance areas or diverting storm water around them, using an oil/water separator to treat runoff from the maintenance area before discharge, segregating incompatible or reactive chemicals to prevent mixing if spills occur, collecting and treating spills separately from the storm water system, and providing secondary containment for fuel and lubricant spills to keep them from contaminating the storm water are also good housekeeping practices.

Acid Mine Drainage

Treatment can be provided for acid mine drainage by installing anoxic limestone drains to intercept acid mine drainage, passing the wastewater through an anaerobic wetland, neutralizing the acidic drainage and collecting and dealing with the sludge produced. Other good practices include isolating and reclaiming the waste material so as to restrict water access; covering acid mine waste to prevent access of surface and rainwater; diverting water flows around acidic mine waste where possible; constructing and maintaining artificial wetlands as water treatment systems; and using, restoring and maintaining natural wetlands as water treatment systems.

Reclamation

Erosion and pollution from mine tailings can be minimized through land reclamation. Tailings can be modified and/or isolated from the surrounding environment. Modification can be done through leaching, applying amendments, and using biological treatment. Isolation involves separation of tailings from potential receiving waters and can include construction of barriers and depth isolation.

TABLE 4. Mining Practices

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
SEDIMENT AND EROSION													
Biotechnical Stabilization	S							✓					
Compaction	S							✓					
Dust Control	S					✓							
Erosion Control Blanket	S							✓					
Gabions	S							✓					
Limited Surface Disturbance	S						✓						
Matting	S							✓					
Mulching	S							✓					
Native Rock Retaining Walls	S							✓					
Riprap	S							✓					
Sodding	S						✓	✓					
Surface Roughening	S					✓							
Temporary Gravel Construction Access	S							✓					
Temporary and Permanent Seeding	S							✓					
Timing of Construction	S	✓											
Maintenance of Revegetated Areas	S						✓						
Seedbed Preparation	S							✓					
Topsoiling	S							✓					
Vegetative Planting	S							✓					
Culverts	S			✓									

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Sediment and Erosion (continued)													
Diversion Dike/Ditch	S			✓									
Drainfields	S			✓									
Drop Structures	S							✓					
Hardened Channels	S			✓				✓					
Interceptor Trench	S			✓									
Open Top Box Culverts	S			✓									
Outlet Stabilization Structure	S							✓					
Paved Flume	S			✓				✓					
Road Sloping	S			✓									
Roadway Surface Water Deflectors	S			✓									
Rolling Dips	S			✓									
Runoff Diversion	S			✓									
Siltation Berm	S												✓
Temporary Slope Drain	S			✓									
Waterbars	S			✓									
Benched Slopes	S							✓					
Level Spreader	S						✓						
Serrated Slopes	S							✓					
Brush Barriers	S						✓						
Brush/Sediment Barriers	S												✓
Check Dam	S							✓					

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Sediment and Erosion (continued)													
Grade Stabilization Structure	S							✓					
Log and Brush Check Dams	S							✓					✓
Sediment Basin	S												✓
Sediment Fence	S												✓
Sediment Trap	S												✓
Silt Fence	S										✓		✓
Slash Filter Windrows	S										✓		✓
Straw Bale Barrier	S										✓		✓
Vegetated Filter Strip	S										✓		
Construction Site Management	F, S	✓											
Leak & Spill Prevention	H, T	✓											
STREAM STABILIZATION													
Check Dam	S							✓					
Grade Stabilization Structure	S							✓					
Streambank Stabilization	S							✓					
Temporary Stream Crossing	S						✓						
ACID MINE DRAINAGE													
Anoxic Limestone Drains	T									✓			
Chemical Treatment	T									✓			
Covering	S, T						✓						
Constructed Wetlands	N, S, T								✓		✓		✓

MINING SECTOR BMPS

Many BMPs listed in the Compendium may be used to curtail pollution in historic mining areas. However, one BMP known as an apatite filter system involves a unique method of reducing metals in groundwater at mine sites. The *Success Millsite Project* is located in the historic Silver Valley Mining District in northern Idaho. Since the early 1900s toxic metals have been contaminating ground and surface water in the area.

This innovative project involved the installation of an activated apatite filter system designed to filter out metals including zinc, cadmium and lead from contaminated mine water. Ground water is collected from a 1.2 million square foot mill tailings impoundment area up gradient of this BMP and is gravity fed into the apatite filter system shown in Photo 14. The crystal lattice of apatite allows metal ions to enter the apatite and be chemically bonded there. On a set schedule, the apatite is then removed from the reaction chamber (the following two photos), sent to a hazardous waste site and replaced with clean apatite.

Construction Phase

▶ *DEQ is monitoring reaction chamber water inflow and outflow for zinc, cadmium and lead. The pregnant apatite is being monitored for metal content. The stream down gradient, is being biomonitored for macro and micro invertebrates.*

Apatite Filter System Completed

Urban Activities/Storm Water Runoff

This sector includes a wide range of activities that can contribute pollutants to streams, lakes, and ground water via storm water runoff. Land development contributes to the problem through the creation of impervious surfaces such as city streets, driveways, parking lots, and sidewalks. Impervious areas act as collectors for pollutants from concentrated human activities. Pollutants can fall out of the sky during dryfall or they may arrive in rain or snow as wetfall. Pollutants can also be blown in from adjacent pervious areas. Pollutants land on street or other impervious surfaces where they often stay in curbs, cracks and other areas until the next rainstorm when they are washed off the surface and into the storm drain system and ultimately to receiving streams. Activities that can contribute pollutants include development activities; activities associated with existing residential, commercial and industrial sources; illicit discharges, and illegal dumping.

The major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, road salts, heavy metals, petroleum hydrocarbons, pathogenic bacteria, and viruses. Suspended sediments constitute the largest mass of pollutant loadings to receiving waters from urban areas. Construction is a major source of sediment erosion. Nutrient and bacterial sources of contamination include fertilizers, pet wastes, leaves, grass clippings, and faulty septic tanks. Petroleum hydrocarbons result mostly from automobile sources.

In addition to water quality impacts, land development impacts the hydrology and geomorphology of the receiving water, and affects aquatic and riparian habitats. Development results in impervious surfaces that eliminate the natural retention provided by vegetation and soil in undeveloped areas. Increasing impervious surfaces increases the quantity of water delivered to a waterbody during storms. This results in increased runoff with more rapid peak discharges. Changes in the volume and timing of runoff can result in stream widening, erosion, decreased channel stability, embeddedness, and decreased substrate quality.

For the purposes of this discussion, urban management practices are organized into the following groups: public education and involvement, municipal operations, illicit discharges, industrial activities, construction sites, and new development. On-site wastewater disposal systems or septic systems are also discussed in this section. While not necessarily an urban source, the use of septic systems on the urban fringe and in rural subdivisions can act as a source of nitrogen, phosphorus, organic matter, and bacterial and viral pathogens.

Public Education and Involvement

Everyday activities have the potential to contribute pollutants to runoff. Some of the major sources include households, garden and lawn care activities, turf grass management, diesel and gasoline vehicles, illegal discharges to urban runoff conveyances, commercial activities, and pets and domesticated animals. Everyday household activities generate numerous pollutants that may affect water

quality. Common household pollutants include paints, solvents, lawn and garden care products, detergents and cleansers, and automotive products such as antifreeze and oil.

These pollutants are typically introduced into the environment due to ignorance on the part of the user or the lack of proper disposal options. Storm drains are commonly mistaken for treatment systems, and significant loadings to waterbodies result from this misconception. Other wastes and chemicals are dumped directly onto the ground.

The practices that address these sources of pollutants can result in behavioral changes. Such activities include public education, promotion of alternative and public transportation, proper management of maintained landscapes, pollution prevention, training and urban runoff control plans for commercial sources. Public education increases awareness of problems and available solutions.

Public involvement will ensure broader public understanding and support, provide a broader base of expertise, and provide additional resources to the program through volunteer activities. Opportunities for members of the public to participate in program development and implementation include serving as citizen representatives on a local storm water management panel, attending public hearings, working as citizen volunteers to educate other individuals about the program, assisting in program coordination with other pre-existing programs, and participating in volunteer monitoring efforts.

Municipal Operations

Municipal operations can be addressed through proper maintenance activities, maintenance schedules, and long-term inspection procedures; controls for reducing or eliminating the discharge of pollutants from areas such as roads and parking lots, maintenance and storage yards, and waste transfer stations; and procedures for the proper disposal of waste removed by maintenance activities. The construction and operation of roads is discussed in greater detail in Section 7.

Illicit Discharges

Significant pollutants can enter surface waters and tributaries via illegal discharges into storm drains. The public assumes that storm drains discharge into sanitary sewers, and materials are dumped into storm drains under the assumption that treatment will occur at the sewage treatment plant. Sources of illicit discharges include such things as car wash wastewaters, improper oil disposal, radiator flushing disposal, sump pump discharges, and improper disposal of household chemicals.

Another source of illicit discharges is possible illicit connections to storm drain systems (e.g. wastewater piping either mistakenly or deliberately connected to storm drains). Types of illicit discharges include such things as sanitary wastewater, effluent from septic tanks, and laundry wastewaters. Sanitary sewer connections can result in fecal coliform bacteria entering the storm sewer system, and floor drains can contribute other non-storm water discharges.

Illicit discharges are addressed through regulation and education. Public education programs, such as storm drain stenciling, and identification of illicit discharges can be effective tools to reduce pollutant loadings. A sanitary surveys is also a useful method to help managers identify the presence and entry point(s) of illicit discharges or other sources of pollutants to storm sewer systems.

Industrial Activities

Activities that take place at industrial facilities, such as material handling and storage, are often exposed to storm water. The runoff from these activities discharges industrial pollutants into nearby storm sewer systems and waterbodies. This may adversely impact water quality.

There are good housekeeping practices, structural controls, site-specific and activity-specific source control practices that can be used to control potential pollutants from industrial activities. The site-specific controls include flow diversion practices, exposure minimization practices, mitigative practices, and a variety of prevention practices.

Construction Sites

Construction site practices control erosion and sediment discharge, as well as other pollutants from paving operations; handling and storage of various materials; spills; and handling wastes such as pesticides, oil and grease, concrete truck washout, construction chemicals, construction debris, solvents, paints, sanding dusts, and fertilizers.

Opportunities for achieving pollutant reductions can be incorporated into the site plan review and land use planning processes. An erosion and sediment control ordinance can be implemented through the site planning process and verified through the review process.

Construction site management practices can be categorized as erosion control practices, which prevent or minimize erosion; sediment control practices, which attempt to capture soil released through erosion; and source controls. Erosion control includes various practices designed to keep water from coming in contact with bare soil or controlling its velocity if it does. Sediment trapping is used for sediment control. The two basic types of sediment trapping techniques in use are sediment barriers and settling ponds. Source controls are used in the management of other construction site pollutants.

New Development

Structural and non-structural practices are available to address post-construction development impacts. Structural controls include infiltration devices, detention and retention basins, vegetated swales, water quality inlets, screens and filters, channel stabilization, riparian habitat enhancement efforts, and wetland restoration projects.

Non-structural practices are preventative actions that involve management and source controls such as:

- Policies and ordinances that provide requirements and standards to direct growth to identified areas, protect sensitive areas such as wetlands and riparian areas, maintain and/or increase open space, provide buffers along sensitive water bodies, minimize impervious surfaces, and minimize disturbance of soils and vegetation;
- Policies or ordinances that encourage infill development in higher density urban areas and areas with existing infrastructure; and
- Practices such as minimization of percent impervious area after development and minimization of directly connected impervious areas.

Storm water management can be achieved by relying on existing land development requirements, strengthening or developing new storm water codes and ordinances, and using the site plan review process to ensure that appropriate storm water codes and ordinances are implemented. Land use planning is an additional process that precedes (but does not replace) the site plan review process. The planning process typically involves the setting of land use goals and objectives for various parts of a municipality into a plan document or onto a plan map. Water quality can be addressed by incorporation of policies regarding storm water quality into the land use.

Septic Systems

On-site sewage disposal systems or septic systems can act as sources of nitrogen, phosphorus, organic matter, and bacterial and viral pathogens either because of inadequate design, inappropriate installation, neglectful operation, or exhausted lifetime. The greatest design inadequacy associated with conventional septic systems is the failure to remove nitrogen effectively.

Inappropriate installation often involves improper siting, including locating in areas with inadequate separation distances to ground water, inadequate absorption areas, fractured bedrock, sandy soils, inadequate soil permeability, or other conditions that prevent adequate treatment of wastewater if not accounted for. Inappropriate installation can also include smearing of trench bottoms during construction, compaction of the soil bed by heavy equipment, and improperly performed percolation tests.

Hydraulic overloading is responsible for the majority of system failures related to system operation. Regular inspection and

maintenance are necessary and often do not occur. Finally, conventional septic systems are designed to operate over specified periods of time. At the end of the expected life span, replacement is generally necessary. Homeowners may be unaware of this issue or unable to afford a replacement.

One good management practice for septic systems is to place it away from an unsuitable area. Where placement in unsuitable areas is not practicable, then alternative systems should be considered or systems should be designed or sited at a density so as not to adversely affect surface waters or ground water. Protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative systems should be established. Protective separation distances between system components and ground water should also be established.

In addition to soil criteria, setbacks, and separation distances, management and maintenance requirements should be established. Local jurisdictions can establish and implement policies and systems to ensure that existing systems are operated and maintained. Management options for maintenance include maintaining the system via contract, requiring operating permits, using private management systems, and passing local ordinances.

Policies can be established that require a system be repaired, replaced, or modified when it fails, threatens, or impairs surface waters. Systems should be inspected at a frequency adequate to ascertain whether they are failing. One way to reduce the possibility of failed systems is to require scheduled pumpouts and regular maintenance. Inspections upon resale or change of ownership of properties are also a cost-effective solution to ensure that systems are operating properly and meet current standards necessary to protect surface waters.

TABLE 5. Urban/Storm Water Practices

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
PUBLIC EDUCATION														
Proper Disposal of Household Hazardous Wastes	T	✓												
Pet Waste Management	B, N		✓											
Pollution Prevention for Business	All	✓												
Educational Programs for School Age Children	All	✓												
Storm Drain Stenciling	All					✓								
PUBLIC INVOLVEMENT														
Community Cleanups	F					✓								
Adopt-A-Stream Programs	All					✓								
Community Hotlines	All					✓								
ILLICIT DISCHARGE DETECTION														
Identify Illicit Connections	All					✓								
Repair Leaking Sewer Lines	B, N					✓								
Hookup Failing Septic Systems to Sanitary Sewer	B, N					✓								
Prohibit Illegal Dumping	All	✓												
Dry Weather Outfall Screening	All	✓												
CONSTRUCTION SITE CONTROLS														
Sediment Control	S													✓

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Construction Site Controls (continued)													
Construction Entrance and Roads	S							✓					
Permanent Stabilization	S							✓					
Runoff Controls	S			✓									
Storm Drain Inlet Protection	S						✓						
Source Controls	N, H, T, S	All											
INDUSTRIAL CONTROLS													
Vehicle and Equipment Fueling	H	✓											
Vehicle and Equipment Maintenance and Repair	N, H, T	✓											
Outdoor Loading/ Unloading	All	✓											
Outdoor Process Equipment Operations	All	✓											
Outdoor Storage	All	✓											
Waste Handling and Disposal	All		✓										
Building and Grounds Maintenance	N, T, S		✓										
Spill Prevention and Control	All	✓											
NONSTRUCTURAL CONSTRUCTION CONTROLS													
Site Plan Review Procedures	S	✓											

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL				
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Non-Structural Construction Controls (continued)													
Contractor Education	S	✓											
STRUCTURAL CONTROLS FOR DEVELOPMENT See *State of Idaho Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* (DEQ, 2001)													
NONSTRUCTURAL DEVELOPMENT CONTROLS													
Buffer Zones	B, N, S					✓	✓						
Open Space Design	B, N, S					✓	✓						
Comprehensive Planning/ Zoning	All	✓											
Integrative Ordinances	All	✓											
Site-Based Local Controls	B, N, S	✓											
Low Impact Development Techniques	B, N, S					✓	✓						
MUNICIPAL OPERATIONS													
Parking Lot Cleaning	B, N, H, T, S		✓										
Street Sweeping	B, N, H, T, S		✓										
Storm Drain System O&M	B, N, H, T, S		✓										
Vehicle Maintenance Practices	H, T	✓											
Employee Training	All	✓											
Materials Management	All	✓											
Snow Removal/Deicing Practices	N, S		✓										
Storm Water System Retrofitting	N, S								✓		✓		✓
Vegetation Management	B, N, S	✓											

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Municipal Operations (continued)													
Riparian Area Management	B, N, S, TP						✓						
Revegetation	B, N, S, TP						✓	✓					
Streambank Stabilization	N, S							✓					
Urban Forestry	N, S, TP					✓							
ON-SITE DISPOSAL SYSTEMS													
Siting Criteria	B, N	✓											
Design and Construction	B, N	✓							✓		✓	✓	
Operation and Maintenance	B, N	✓											
Alternative Systems	B, N								✓		✓	✓	

URBAN STORM WATER SECTOR BMPS

There are a number of new stream channel restoration projects along Paradise Creek within the City of Moscow. Where previously in the mid 1900s the stream channel had been straightened, deepened, and lined with rip rap to allow for development, a large and diverse group of stakeholders led by the Palouse-Clearwater Environmental Institute are now conducting a superb effort to recreate a meandering channel and flood plain.

◄ *The work being accomplished as shown in this photo will reduce the amount of sediment entering the creek from urban storm water runoff and alleviate the erosion that was occurring along the streambanks. This work combined with recreation of flood plains and reestablishment of native vegetation will return this stream segment to a fish friendly environment.*

The wetland retention pond shown here will serve the multiple purposes of filtering storm water prior to discharge to Paradise Creek, creation of good habitat for urban wildlife and creation of an aesthetically pleasing park-like wildlife study area for local students. Each of the blue plastic sleeves protects a newly planted native woody or herbaceous species plant.

In order to ensure that urban area BMPs are fostered, maintained and protected BMPs such as public involvement and public education are essential. The events shown in this photo and the photo on the following page took place several months after the heavy construction seen on page 51.

Over 200 school children planted trees and shrubs at the second annual Paradise Creek Watershed Festival. The October 2002 festival was part of the local match for a Clean Water Act section 319 project designed to construct a functional flood-plain, recreate meanders, stabilize stream banks, and plant a native riparian vegetation buffer along Paradise Creek in northern Idaho.

Transportation Activities

Categories of activities in the transportation sector include road construction, operation and maintenance, and post-construction runoff. Erosion during and after construction of roads, highways, and bridges can contribute large amounts of sediment and silt to runoff waters, which can deteriorate water quality and lead to fish kills and other ecological problems. Heavy metals, oils, other toxic substances, and debris from construction traffic and spillage can be absorbed by soil at construction sites and carried with runoff water. Pesticides and fertilizers used along roadway rights-of-way and adjoining land can pollute surface waters and ground water when they filter into the soil or are blown from the area where they are applied. Runoff controls are essential to preventing polluted runoff from roads, highways, and bridges from reaching surface waters.

Road Construction

Practices are implemented during site development and land disturbing activities for new, relocated, and reconstructed roads and highways in order to reduce the generation of runoff and to mitigate the impacts of urban runoff and associated pollutants from such activities. The best time to address control of pollution from roads and highways is during the initial planning and design phase. New roads and highways should be located with consideration of natural drainage patterns and planned to avoid encroachment on surface waters and wet areas. Adequate setback distances near wetlands, waterbodies, and riparian areas should be provided to ensure protection from encroachment in the vicinity of these areas. Locations requiring excessive cut and fill; subject to subsidence; or with sinkholes, landslides, rock outcroppings, and highly erodible soils should be avoided.

Construction site management is the application of erosion and sediment control during the life of the construction phase of a project. Construction site management not only covers the actual construction area, but also applies to construction support areas such as staging areas, materials source or stockpiling areas, and construction-related areas, such as batch plants located off site.

Temporary erosion and sediment control practices are short-term practices used to reduce or eliminate erosion and are designed and installed to keep as much sediment on site as possible. These practices are used when areas are disturbed due to construction, or when an emergency such as a slide or flood has occurred. A temporary erosion and sediment control practice is normally used for one to six months, or until a more permanent practice is put into place.

Post-Construction Runoff Controls

Permanent erosion and sediment control practices and storm water runoff controls are long-term practices, designed for the life of a project. Permanent controls are designed to reduce or control erosion and storm water runoff and are put in place during construction with beneficial results extending over a period of years. Examples of permanent storm water controls are vegetated filter strips, grassed swales, pond systems, infiltration systems, constructed urban runoff wetlands, and energy dissipaters and velocity controls.

Operation and Maintenance

Substantial amounts of eroded material and other pollutants can be generated by the operation and maintenance of roads, highways, and bridges, and from sparsely vegetated areas, cracked pavement, potholes, and poorly operating urban runoff control structures. Good practices related to these activities consist of using standard operating procedures for nutrient and pesticide management, minimizing road salt use, and following maintenance guidelines (e.g., capture and contain paint chips and other particulates from bridge maintenance operations, resurfacing, and pothole repairs).

TABLE 6. Transportation Practices

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
DESIGN PRACTICES													
Avoid Sensitive Areas	S	✓					✓						
Setbacks	S						✓						
Downstream Effects Evaluation	Not Applicable	✓											
Preservation of Existing Vegetation	N, S	✓					✓						
CONSTRUCTION PRACTICES													
Construction Site Management	F, H, S, T	✓											
Dust Control	S					✓							
Preservation of Existing Vegetation	N, S						✓						
Scheduling/Sequencing	S	✓											
Staging and Materials Site Management	F, S	✓											
Temporary Roads	S							✓					
Construction Entrances	S							✓					
EROSION AND SEDIMENT CONTROL													
Check Dams	S							✓					
Coffer Dams	S			✓									
Dikes and Berms	S			✓									
Diversion Channels	S			✓									
Inlet Protection	S						✓						
Outlet Protection	S						✓						

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Erosion and Sediment Control (continued)														
Perimeter Protection	S						✓						
Sediment Trap Basins	S			✓									✓
Slope Drains	S			✓									
Stream Crossing	S						✓						
Soil Stabilization	S							✓					
Vegetation/Seeding	S						✓	✓					
Vegetation/Planting	S						✓	✓					
POST-CONSTRUCTION CONTROLS														
Check Dams	S							✓					
Flexible Liners	S				✓								
Rigid Channel Liner	S				✓								
Dikes and Berms	S				✓								
Geosynthetics	S							✓					
Inlet Protection	S						✓						
Outlet Protection	S						✓						
Interceptor Trench	S			✓									
Structural Treatment Practices	B, N, H, T, S								✓		✓	✓	✓
OPERATION AND MAINTENTANCE PRACTICES														
Litter and Debris Removal	F		✓										
Vegetation Control	S	✓											
Snow Removal and De-icing	N, S	✓											

continued

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
Operation and Maintenance Practices (continued)														
Sweeping and Vacuuming	B, N, H, T, S		✓										
Maintenance Facility Housekeeping Practices	B, N, H, T, S		✓										
Illicit Connection Detection and Removal	B, N, H, T, S				✓								
Illegal Discharge Control	B, N, H, T, S	✓			✓								
Storm Drain Inspection and Maintenance	B, N, H, T, S	✓											

The *Paradise Creek TMDL Implementation Project* is one of Idaho's largest and most successful nonpoint source pollution abatement projects. This project is overseen by the Palouse-Clearwater Environmental Institute and is funded in part through Idaho DEQ's NPS/319 grant program. Paradise Creek drains 35 square miles including 55 stream segments. Forty-nine segments originate in agricultural fields north of Moscow, Idaho and the balance originating within city limits. The upper Paradise Creek Watershed consists of wind derived silt and clay locally referred to as the Palouse Country. When Palouse Country fields are tilled this fine-grained material becomes extremely vulnerable to erosion.

▶ *This segment of Paradise Creek (concealed by vegetation along the left side) runs along the urban/rural boundary just north of Moscow, Idaho. The hay field (right side of photo) used to be cultivated right up to the creek bank resulting in considerable erosion and sedimentation of Paradise Creek. Now, through cooperation from the landowner, this permanent zone of thick grass prevents erosion of sediment and nutrients when the hay field is cultivated.*

The BMP shown here known as a gully plug is a small constructed retention basin with a riser and an underdrain pipe system that discharges several hundred feet down gradient where the terrain is nearly flat. A frequent application of this BMP allows maximum acreage to be cultivated with a minimum of erosion.

In the upper Paradise Creek Watershed not far down hill from the gully plug previously described, these men are walking up a watercourse that is permanently covered with grass. Used as an alternative to gully plugs this vegetative strip BMP displaces cash crops but offers a good driving surface for farm equipment while preventing erosion. Vegetative strips are used in more pronounced waterways where gully plugs would not be adequate. Note that the hills on both sides have been prepared using no-till techniques for crops.

Marinas and Recreational Boating

Marinas may pose a threat to the health of aquatic systems and may pose other environmental hazards when these facilities are poorly planned or managed. Ensuring the best possible siting for marinas, as well as the best available design and construction practices and appropriate operation and maintenance practices, can greatly reduce polluted runoff pollution from marinas.

Because marinas are located right at the water's edge, there is often no buffering of the release of pollutants to waterways. Adverse environmental impacts may result from the following situations of pollution associated with marinas and recreational boating:

- Poorly flushed waterways where dissolved oxygen deficiencies exist;
- Pollutants discharged from boats;
- Pollutants transported in storm water runoff from parking lots, roofs, and other impervious surfaces;
- The physical alteration or destruction of wetlands and of shellfish and other bottom communities during the construction of marinas, ramps, and related facilities; and
- Pollutants generated from boat maintenance activities on land and in the water.

A marina can have a significant impact on the concentrations of pollutants in the water, sediment, and tissues of organisms within the marina itself. Although sources of pollutants outside the marina are part of the problem, marina design, operation, and location appear to play crucial roles in determining whether local water quality is impacted. Marina construction may alter the type of habitat found at the site. Some of the impacts that can be associated with marina and boating activities include toxicity in the water column from discharges from boats or other sources, spills, or storm water runoff; fecal coliform bacteria in areas with high boat densities and low hydrologic flushing; habitat destruction and increased turbidity from boat operation and dredging; and shoaling and shoreline erosion from the physical transport of sediment due to waves and/or currents.

Marinas Siting and Design

In selecting a marina site and developing a design, consideration of the need for the efficient flushing of marina waters should be a prime factor along with safety and vessel protection. For example, sites located on open water or at the mouths of creeks and tributaries usually have higher flushing rates. These sites are generally preferable to sites located in coves or toward the heads of creeks and tributaries, locations that tend to have lower flushing rates.

Assessments of water quality conditions and habitat prior to marina development are another practice for protecting water quality. The first step in a marina water quality assessment should be the evaluation and characterization of existing water quality conditions. Before an analysis of the potential impacts of future development is made, it

should be determined whether current water quality is acceptable, marginal, or substandard. The second step in a marina water quality assessment is to set design standards in terms of water quality.

A habitat assessment is a practice used to characterize a proposed project site and is done to achieve compatibility between development and resources. A site's physical properties are assessed. To minimize potential impacts, available habitat and seasonal use of the site by benthos, macroinvertebrates, and fish should be evaluated. Once these data are assembled, it becomes possible to identify environmental risks associated with development of the site.

Shoreline Stabilization

Activities associated with a marina and boating operations can cause shoreline erosion. Planting vegetation can stabilize shorelines. This approach has shown the greatest success in low-wave-energy areas where underlying soil types provide the stability required for plants and where conditions are amenable for sustaining of plant growth. Under suitable conditions, an important advantage of vegetation is its relatively low initial cost. Identification of the cause of the erosion problem is essential for selecting the appropriate technique to remedy the problem.

Some structural methods to stabilize shorelines and navigation channels are bulkheads, jetties, and breakwaters. They are designed to dissipate incoming wave energy. While structures can provide shoreline protection, unintended consequences may include accelerated scouring in front of the structure, and increased erosion of unprotected downstream shorelines. Gabions, riprap, and sloping revetments dissipate incoming wave energy most effectively and result in the least scouring. Bulkheads are appropriate in some circumstances, but where alternatives are appropriate the alternatives should be used first.

Storm Water Runoff

Source controls and structural facilities can be used to control storm water runoff from a marina. Structural facilities include sand filters, ponds, wetlands, infiltration basins and trenches, chemical and filtration treatment systems, vegetated filter strips and grassed swales, porous pavement, oil-grit separators, catch basins, absorbents in drain inlets, holding tanks, and swirl concentrators. Source controls are applied to activities that occur on site and reduce or control the potential for pollutants to be discharged. Leak and spill prevention is one example.

Sewage Facility Management

Management systems for controlling pollutants from sewage facilities include fixed-point systems, portable systems, and dedicated slipside systems. Fixed-point collection systems include one or more centrally located sewage pumpout stations. Portable systems are similar to fixed-point systems and in some situations may be used in their place at a fueling dock. The portable unit includes a pump and a small storage tank connected to the deck fitting on the vessel, and wastewater is pumped from the vessel's holding tank to the pumping unit's storage tank. Dedicated slipside systems provide continuous wastewater collection at a slip. Marina operators should also post ample signs prohibiting the discharge of sanitary waste from boats into the waters of the state, including the marina basin, and also explaining the availability of pumpout services and public restroom facilities.

Sewage facility maintenance can be addressed through maintenance contracts with contractors competent in the repair and servicing of pumpout facilities, a regular inspection schedule, adding language to slip leasing agreements mandating the use of pumpout facilities and specifying penalties for failure to comply, and placing dye tablets in holding tanks to discourage illegal disposal.

Waste Management

Solid waste can be controlled at marinas by designating work areas for boat repair and maintenance, regularly maintaining these areas, providing proper disposal facilities, and facilities for recycling appropriate materials. Establishing fish cleaning areas and cleaning rules, educating boaters, and implementing fish composting where appropriate can also control fish waste. Practices to control liquids

include building curbs, berms, or other barriers around areas used for the storage of liquid material to contain spills; separating containers for the disposal of waste liquids; and directing marina patrons as to the proper disposal of all liquid materials through the use of signs, mailings, and other means.

Fueling Operations

Potential pollutants from fueling stations can be prevented by locating and designing fueling stations so that spills can be contained in a limited area, having a spill contingency plan, and designing fueling stations with spill containment equipment.

Fuel and oil are commonly released into surface waters during fueling operations through the fuel tank air vent, during bilge pumping, and from spills directly into surface waters and into boats during fueling. Oil and grease from the operation and maintenance of inboard engines are a source of petroleum in bilges. Petroleum control can be achieved through the use of automatic shut-off nozzles and fuel/air separators on air vents or tank stems of inboard fuel tanks to reduce the amount of fuel spilled into surface waters during boat fueling. The use of oil-absorbing materials in the bilge areas of all boats with inboard engines can also be promoted.

Boat Operations

Management practices that affect boat operations include excluding motorized vessels from areas that contain important shallow-water habitat and establishing and enforcing no-wake zones to decrease turbidity. Boat cleaning practices to protect water quality include washing the boat hull above the waterline by hand and using detergents and cleaning compounds that are phosphate-free and biodegradable.

The best method of preventing pollution from marinas and boating activities is to educate the public about the causes and effects of pollution and methods to prevent it. Creating a public education program should involve user groups and the community in all phases of program development and implementation. The program should be suited to a specific area and should use creative promotional material to spread its message. Examples of practices include signage, recycling and trash reduction programs, pamphlets or flyers, newsletters, inserts in billing, and meetings and presentations.

TABLE 7. Marina and Recreational Boating Practices

PRACTICE *(ADDITIONAL SOURCES OF INFORMATION)*	TARGETED POLLUTANTS B bacteria F floatables N nutrients DO dissolved oxygen H hydrocarbons TP temperature T toxics S sediment	MECHANISM												
		SOURCE CONTROL							TREATMENT CONTROL					
		Managerial/ Operational	Good Housekeeping	Collection/ Conveyance	Containment	Reduction/ Elimination	Protection	Stabilization	Biological Treatment	Chemical Treatment	Filtration	Infiltration	Sedimentation
MARINA SITING AND DESIGN													
Marina Flushing	All	✓											
Water Quality Assessment	NA						✓						
Habitat Assessment	NA						✓						
SHORELINE STABILIZATION	S							✓					
Storm Water Controls	All	All											
SEWAGE CONTROL													
Sewage Facilities													
Dedicated Slipside System													
Portable System	B, N			✓	✓								
Sewage Facility Maintenance	B, N		✓										
WASTE MANAGEMENT													
Solid Waste	F		✓										
Fish Waste Composting Facility	B, N				✓				✓				
Liquid Materials			✓										
FUELING OPERATIONS													
Fueling Station	H		✓		✓								
Petroleum Management	H	✓	✓										
BOAT OPERATIONS													
Boat Cleaning	N, T				✓								
Boat Operation	H, N					✓							
Public Education	All	✓											

The *Bear River Fencing and Riparian Enhancement Project* is located in the southeast corner of Idaho in Bear Lake County. A stretch of Bear River has been subject to decades of improper grazing resulting in badly sloughed riverbanks and loss of riparian vegetation. Fencing and revegetation have allowed the riverbank to regain much of its original shape and function (left). The watering gap shown below is a simple solution that allows cattle to remain grazing in the area without destruction of miles of riverbank.

The *OX Ranch Agricultural BMP Implementation Project* was designed to improve water flows and fish habitat in the Lick Creek drainage. Located in west central Idaho, Lick Creek drains into the Wildhorse River, which in turn drains into the Snake River. All three drainages are listed as impaired water bodies. Irrigation water was diverted from Lick Creek and transported in ditches to the OX ranch to be used for irrigation. Prior to this project the NRCS estimated that water lost through ranch irrigation ditch banks was as high as 75%. In other words, only 25% of the water diverted from Lick Creek was actually being applied to the hundreds of acres of crop and pasture lands owned by the OX Ranch.

▶ *Water that used to be conveyed along a leaky irrigation ditch now is moved through a pipeline. This photo shows one of nine water tanks installed along the pipeline. The pipeline spans approximately 3.1 miles of open ditch. This project furnishes water to 145 acres of land and carries approximately 5.9 cubic feet per second of water.*

The pipeline spans approximately 3.1 miles of open ditch. This project furnishes water to 145 acres of land and carries approximately 5.9 cubic feet per second of water.

◂ *This portion of the pipeline is being used for irrigation. However, there are also livestock on this ranch that must be watered.*

This photo shows one of two stock ponds with overflow systems created along the 3.1-mile-long pipeline.

APPENDIX A

Glossary

Access Restriction, Forest Roads: Wherever possible, completely close the road to travel and restrict access by unauthorized persons by using gates or other barriers. Evaluate the future need for a road and close roads that will not be needed. Leave closed roads and drainage channels in a stable condition to withstand storms.

Access Road, Agriculture: A travel-way for equipment and vehicles constructed as part of a conservation plan to provide a fixed route for vehicular travel for resource activities involving the management of timber, livestock, agriculture, wildlife habitat, and other conservation enterprises while protecting the soil, water, fish, wildlife, and other adjacent natural resources.

Access Road, Forest: A temporary or permanent road over which timber is transported from a loading site to a public road. Also known as a haul road.

Adopt-A-Stream Programs: Volunteer programs, in which participants "adopt" a stream, creek, or river to study, clean up, monitor, protect, and restore.

Adsorbents in Drain Inlets: Adsorbent material placed in drain inlets in a manner that will allow sufficient contact between the adsorbent and the storm water will remove much of the oil and grease load of runoff.

Aeration of Reservoir Waters and Releases: The practice of reservoir aeration relies on atmospheric air, compressed air, or liquid oxygen to increase concentrations of dissolved oxygen in reservoir waters before they pass through dams.

Alley Cropping: Trees or shrubs planted in a set or series of single or multiple rows with agronomic, horticultural crops or forages produced in the alleys between the rows of woody plants.

Alternative On-Site Treatment Systems, Wastewater: Alternatives to septic systems for on-site wastewater treatment such as mound systems, intermittent sand filters, re-circulating sand filters, and evapotranspiration and evapotranspiration/absorption systems.

Anoxic Limestone Drains (ALD): An ALD is simply a quantity of high quality limestone, sealed in plastic to maintain anaerobic conditions, typically buried in a trench over which the drainage water is passed. The limestone reacts with the free protons to impart bicarbonate-buffering capacity to the ALD.

Avoid Sensitive Areas: Locations near critically erodible or environmentally sensitive areas, including natural drainage ways, lakes, ponds, springs, high water tables, floodplains, and wetlands, are avoided in the siting, design, and construction of a project.

Barb or Partial Drop Structure: A barb or partial drop structure decreases stream gradient, dissipates stream energy, and redirects stream flow.

Bench Slopes: Large steps in a slope face useful for providing favorable sites for

establishing vegetation and controlling runoff. Benches can help stabilize large excessively steep slopes in highly cohesive materials. This method is most applicable in newly constructed areas.

Bioengineering: The installation of living plant material as a main structural component in controlling problems of land instability where erosion and sedimentation are occurring. Soil bioengineering provides an array of practices that are effective for both prevention and mitigation of problems. This applied technology combines mechanical, biological, and ecological principles to construct protective systems that prevent slope failure and erosion.

Bioretention: Bioretention areas are landscaping features adapted to provide on-site treatment of storm water runoff. They are commonly located in parking lot islands or within small pockets of residential land uses.

Biotechnical Stabilization: Biotechnical stabilization involves using live layers of brush imbedded in the ground to control or prevent surficial erosion and mass failure of slopes.

Boat Cleaning: This practice minimizes the use and release of potentially harmful cleaners and bottom paints to marina and surface waters.

Boat Operation: This practice prohibits boat operation in areas are not suitable for boat traffic due to their shallow water depth, ecological importance, and sensitivity to disruption of the types of habitats in the area. Excluding boats from such areas will minimize direct habitat destruction. Establishing no-wake zones will minimize the indirect impacts of increased turbidity (e.g., decreased light availability).

Branchpacking: A bioengineering technique that consists of alternating layers of live branch cuttings and compacted backfill to repair small localized slumps and holes in slopes.

Broad-based Dip Construction: A broad-based dip is a gentle roll in the centerline profile of a road that is designed to be a relatively permanent and self-maintaining water diversion structure and can be traversed by any vehicle.

Brushlayering: A bioengineering technique that consists of placing live branch cuttings in small benches excavated into the slope. Brushlayering is somewhat similar to live fascine systems because both involve the cutting and placing live branch cuttings on slopes. The two techniques differ principally in the orientation of the branches and the depth to which they are placed in the slope.

Brush Barriers: Brush barriers are slash materials piled at the toe slope of a road or at the outlets of culverts, turnouts, dips, and water bars. Brush barriers should be installed at the toe of fills if the fills are located within 150 feet of a defined stream channel.

Brush/Sediment Barriers: Temporary sediment barriers constructed of limbs, weeds, vines, root mat, soil, rock, or other cleared materials piled together to form a berm, and located across or at the toe of a slope susceptible to sheet and rill erosion.

Brush/Vegetation Management: Managing and manipulating stands of brush (and weeds) on range, pasture, and recreation and wildlife areas by mechanical, chemical, or biological means or by prescribed burning. (Includes reducing excess brush (and weeds) to restore the natural plant community balance and manipulating stands of undesirable plants through selective and patterned treatments to meet the specific needs of the land and objectives of the land user.)

Brush Mattressing: A bioengineering technique that involves digging a slight depression on the bank and creating a mat or mattress from woven wire or single strands of wire and live, freshly cut branches from sprouting trees or shrubs.

Buffer Strips/Zones: Strips of erosion-resistant vegetation between a waterway, or other natural area, and an area of more intensive use. Buffer strip areas decrease the velocity of storm water runoff, which helps to prevent soil erosion.

Building and Grounds Maintenance: Preventing or reducing the discharge of pollutants from building and grounds maintenance, by washing and cleaning up with as little water as possible, preventing and cleaning up spills immediately, keeping debris from entering the storm drains, and maintaining the storm water collection system.

Cable Yarding Practices: Using cabling systems or other systems when groundskidding exposes excess mineral soils and induces erosion and sedimentation. Avoid cable yarding in or across watercourses. Yard logs uphill rather than downhill. Full log suspension is preferred over partial suspension to minimize ground disturbances. Downhill yarding may be preferred in cases where it results in less roads.

Catch Basins: Catch basins with flow restrictors may be used to prevent large pulses of storm water from entering surface waters at one time. They provide some settling capacity because the bottom of the structure is typically lowered 2 to 4 feet below the outlet pipe. Above- and below-ground storage is used to hold runoff until the receiving pipe can handle the flow.

Catch Basin with Sand Filter: A catch basin with sand filter consists of a sedimentation chamber and a chamber filled with sand. The sedimentation chamber removes coarse particles, helps to prevent clogging of the filter medium, and provides sheet flow into the filtration chamber. The sand chamber filters smaller-sized pollutants.

Channel Stabilization: Channel stabilization utilizes hydraulic structures to stabilize stream channels, as well as to control stream sediment load and transport.

Channel Vegetation: Establishing and maintaining adequate plants on channel banks, berms, spoil, and associated areas to stabilize channel banks and adjacent areas, reduce erosion and sedimentation, and maintain or enhance the quality of the environment, including visual aspects and fish and wildlife habitat.

Check Dam: A small porous or nonporous dam constructed across a drainageway to reduce channel erosion by restricting flow velocity. Check dams should not be used in live streams. They can serve as emergency or temporary practices in small eroding channels that will be filled or permanently stabilized at a later date. They can also serve as permanent structures that will sediment in over time in gullies. This usage in more common in range and agricultural settings.

Check Dam Systems: Check dam systems provide beneficial sediment-reduction functions by trapping sediment behind the dams.

Chemical and Filtration Treatment Systems: Chemical treatment of wastewater is the addition of certain chemicals that cause small solid particles to adhere together to form larger particles that settle out or can be filtered. Filtration systems remove suspended solids by forcing the liquid through a medium, such as folded paper in a cartridge filter.

Chemical Management: Practices used in applying, mixing, loading, and disposing of pesticides and fertilizers.

Chemical Treatment: A process for ameliorating acid mine drainage that involves capturing the discharge and treating it to neutralize, remove metals from, and soften the water.

Chiseling and Subsoiling: Loosening the soil, without inverting and with a minimum of mixing of the surface soil, to shatter restrictive layers below normal plow depth that inhibit water movement or root development.

Closure of Waste Impoundments: The closure of waste impoundments (treatment lagoons and waste storage ponds), which are no longer used for their intended purpose, in an environmentally safe manner.

Coffer Dam: A temporary structure built into a waterway to contain or divert movement of water and to provide a reasonable dry construction area.

Community Cleanups: Special trash collection events along local waterways, on beaches and around storm drains to remove litter and debris.

Community Hotlines: Community hotlines provide a means for concerned citizens and agencies to contact the appropriate authority when they see water quality problems. A hotline can be a toll-free telephone number or an electronic form linked directly to a utility or government agency, such as the water quality control board.

Compaction: A mechanical method of increasing the density of soil to reduce settling and improve resistance to erosion.

Composting Facility: A facility for the biological stabilization of organic waste material.

Comprehensive Planning and Zoning: Zoning is the division of a municipality or county into districts for the purpose of regulating land use. Usually defined on a map, the allowable uses within each zone are described in an official document, such as a zoning ordinance. Zoning is enacted for a variety of reasons, including preservation of environmentally sensitive areas and areas necessary to maintain the environmental integrity of an area.

Conservation Cover: Establishing and maintaining perennial vegetative cover to protect soil and water resources on land retired from agricultural production.

Conservation Crop Rotation: Growing crops in a recurring sequence on the same field.

Conservation Cropping Sequence: An adapted sequence of crops designed to provide adequate organic residue for maintenance or improvement of soil tilth.

Conservation Tillage: Any tillage or planting system that maintains at least 30 percent of the soil surface covered by residue after planting to reduce soil erosion by water; or, where soil erosion by wind is the primary concern, maintains at least 1,000 pounds of flat, small-grain residue equivalent on the surface during the critical erosion period.

Constructed Systems or Devices: Constructed devices or retrofits to existing machinery or operations that can detect equipment failures or leaks, contain contaminants at the source, or catch spilled chemicals.

Constructed Wetlands: Constructed wetlands are a subset of created wetlands designed and developed specifically for water treatment. They have been further defined as engineered systems designed to simulate natural wetlands to exploit the water purification functional value for human use and benefits.

Construction and Operating Standards: Requirements that limit impervious surfaces, encourage open space, locate high-risk activities away from drinking water sources, or encourage cluster development to reduce runoff.

Construction Road/Entrance Stabilization: Stabilizing and maintaining access roads, subdivision roads, parking areas, and other on-site vehicle transportation routes immediately after grading to prevent soil erosion and control dust.

Construction Site Management: The application of controls to the entire construction site during the construction phase of a project to minimize any adverse environmental impacts.

Contour Buffer Strips: Narrow strips of permanent, herbaceous vegetative cover established across the slope and alternated down the slope with parallel, wider cropped strips.

Contour Farming: Farming sloping land in such a way that preparing land, planting, and cultivating are done on the contour. This includes following established grades of terraces or diversions.

Contour Orchard and Other Fruit Areas: Planting orchards, vineyards, or small fruits so that all cultural operations are done on the contour.

Contour Stripcropping: Growing crops in a systematic arrangement of strips or bands on the contour to reduce water erosion.

Contractor Education: Education and certification for key on-site employees who are responsible for implementing construction site practices to protect water quality.

Controlled Drainage: Control of surface and subsurface water through use of drainage facilities and water control structures.

Cover and Green Manure Crop: A crop of close-growing grasses, legumes, or small grains grown primarily for seasonal protection and soil improvement. The crop usually is grown for one year or less, except where there is permanent cover, such as in orchards.

Covering: The partial or total physical enclosure of stockpiled or stored material, loading/unloading areas, or processing operations. Covering is applicable to mining sources such as tailings piles and surface

impoundments used for waste storage and disposal. Drainage from a covering is captured and directed around potential contamination areas.

Critical Area Planting: Planting vegetation, such as trees, shrubs, vines, grasses, or legumes, on highly erodible or critically eroding areas.

Crop Residue Use: Using plant residues to protect cultivated fields during critical erosion periods.

Culverts: Corrugated metal pipes used for runoff collection and conveyance.

Dam, Diversion: A structure built to divert all or part of the water from a waterway or a stream.

Dedicated Slipside Systems: Dedicated slipside systems provide continuous wastewater collection at a slip. Slipside pumpout should be provided to live-aboard vessels. The remainder of a marina can still be served by either marina-wide or mobile pumpout systems.

Deep Tillage: Performing tillage operations below the normal tillage depth to modify the physical or chemical properties of a soil.

Deferred Grazing: Postponing grazing or resting grazing land for prescribed period.

Delayed Seed Bed Preparation: Any cropping system in which all of the crop residue and volunteer vegetation are maintained on the soil surface until approximately three weeks before the succeeding crop is planted, thus shortening the bare seedbed period on fields during critical erosion periods.

Dikes and Berms: An embankment constructed of earth or other suitable materials to protect land against overflow or to regulate water.

Ditch and Turnout Construction: The use of ditches where necessary to discharge water into vegetated areas through the use of turnouts. Ditches are constructed wide and gently sloping, especially in areas with highly erodible soils. Ditches should be stabilized with rock and/or vegetation and outfalls protected with rock, brush barriers, live vegetation, or other means.

Diversion Channel: A channel constructed across the slope with a supporting ridge on the lower side.

Diversion Dike/Ditch: Diversion dikes/ditches are used whenever it is necessary to dispose of concentrated surface water without causing erosion. Diversions should be used in conjunction with a silt fence or sediment pond.

Downstream Effects Evaluation: Impacts from the operation of dams to surface water quality and aquatic and riparian habitat are assessed and the potential for improvement evaluated. Additionally, new upstream and downstream impacts to surface water quality and aquatic and riparian habitat are also considered in the assessment.

Drainage Structure Maintenance: The inspection and maintenance including repair, replacement and clearing of pipes, culverts, underdrains, horizontal drains, and other elements of drainage systems. It also includes removal of silt, debris, and overgrown vegetation to maintain the flood control capacity of drainage ditches.

Drainfields: A drainage system constructed of rock or rock and perforated pipe, used to drain water away from construction sites.

Drop Structures: Natural materials such as rocks and trees that are put in for stream stabilization, controlling water velocities, and creating fish habitat. Placement of a drop structure perpendicular to stream flow will decrease the stream gradient, dissipate stream energy, and decrease stream velocity through an increase in water surface elevation immediately above the structure.

Dry Weather Outfall Screening: Detecting illicit discharges to the storm drain system through visual screening and water sampling from manholes and outfalls during dry weather.

Dust Control: Watering, mulching, sprigging, or applying geotextile materials to a construction area to prevent soil loss as dust.

Equipment Operation and Maintenance: Proper maintenance of vehicles and

household, farm, construction, and industrial equipment.

Emergency Response Planning: Planning for unforeseen circumstances by identifying potential threats and formulating response scenarios.

Employee Training: Training employees regarding practices and inspections to identify potential difficulties before they become major problems.

Erosion Controls: Erosion controls are preventive practices that include limiting disturbance to land and vegetation, scheduling and phasing construction. They also include temporary cover practices, mulches, mates and blankets, and permanent vegetation establishment.

Erosion Control Blanket: Mattings made of natural or synthetic materials that are used to stabilize soil.

Extended Detention Basin: Extended detention ponds temporarily detain a portion of urban runoff for up to 24 hours after a storm, using a fixed orifice to regulate outflow at a specified rate, allowing solids and associated pollutants the required time to settle out. The ponds are normally "dry" between storm events and do not have any permanent standing water.

Evaporation Pond: A pond designed for containing, retaining, and disposing of storm water runoff by way of evaporation.

Fencing: Enclosing or dividing an area of land with a suitable permanent structure that acts as a barrier to livestock, big game, or people (does not include temporary fences).

Field Border: A strip of perennial vegetation established at the edge of a field by planting or by converting it from trees to herbaceous vegetation or shrubs.

Field Strip-Cropping: Growing crops in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion.

Field Windbreak: A strip of permanent vegetation established at the edge or around the perimeter of a field.

Filter Strip: A strip or area of vegetation for removing sediment, organic matter, and other pollutants from runoff and wastewater.

Firebreak: A strip of bare land or vegetation that retards fire.

Fireline Practices: Practices for all bladed firelines, for prescribed fire and wildfire, including plowing on contour or stabilizing with water bars and/or other appropriate techniques if needed to control excessive sedimentation or erosion of the fireline. Wildfire suppression and rehabilitation decisions should consider possible pollution of watercourses, while recognizing the safety and operational priorities of fighting wildfires.

Fish Passage: Modification or removal of barriers that restrict or prevent movement or migration of fish.

Fish Waste Practices: Proper disposal of fish waste through education and provision of adequate and convenient disposal facilities.

Fixed-Point Systems: Fixed-point collection systems include one or more centrally located sewage pumpout station. These stations are generally located at the end of a pier, often on a fueling pier so that fueling and pumpout operations can be combined.

Flexible Liners: Flexible channel protection uses a flexible material as a lining to stabilize and prevent erosion in open drainage channels.

Flow Augmentation: A flushing flow is a high-magnitude, short-duration release from an impoundment for the purpose of maintaining channel capacity and the quality of instream habitat. Minimum flows are needed to keep streambeds wetted to an acceptable depth to support desired fish and wildlife. Seasonal discharge limits can be established to prevent excessive, damaging rates of flow release. Limits can also be placed on the rate of change of flow and on the stage of the river (as measured at a point downstream of a dam facility) to further protect against damage to instream and riparian habitat.

Flow Restrictors: Hydraulic structures to stabilize stream channels, as well as to control stream sediment load and transport.

Forage Harvest Management: The timely cutting and removal of forages from the field as hay, green-chop, or ensilage.

Fueling Station Practices: The location and design of the fueling stations to allow for booms to be deployed to surround a fuel spill, development of a spill contingency plan for fuel storage and dispensation areas, and design of fueling stations with spill containment equipment.

Gabions: Rock-filled wire baskets for use in retaining walls or drainage stabilization.

General Planting and Seeding Specifications: Information applicable to revegetating disturbed lands.

Geosynthetics/Geotextiles: A planar product manufactured from a polymeric material used with soil, rock or other geotechnical-related materials as an integral part of a civil engineering project, structure, or system.

Grade Stabilization Structure: A structure designed to reduce channel grade in natural or constructed watercourses to prevent erosion of a channel that results from excessive grade in the channel bed or artificially increased channel flows. This practice can prevent headcutting or stabilize gully erosion. Grade stabilization structures may be vertical drop structures, concrete or riprap chutes, gabions, or pipe drop structures.

Grass Buffer Strips: A gently sloping area of vegetated cover that runoff flows through before entering a stream, storm sewer, or other conveyance.

Grassed Swales: Grassed swales are low-gradient conveyance channels that may be used in place of buried storm drains. To effectively remove pollutants, the swales should have relatively low slope and adequate length and should be planted with erosion-resistant vegetation.

Grassed Waterway: A natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff.

Grasses and Legumes in Rotation: Establishing grasses and legumes or a mixture of them and maintaining the stand for a definite number of years as part of a conservation cropping system.

Grass-Lined Channel: A swale vegetated with grass that is dry except following storms and serves to convey specified concentrated storm water runoff volumes, without resulting in erosion, to disposal locations. Typical uses include roadside swales, outlets for runoff diversions, site storm water routing, and drainage of low areas.

Grazing Land Mechanical Treatment: Modifying physical soil and/or plant conditions with mechanical tools by treatments such as pitting, contour furrowing, and ripping or sub-soiling.

Groins: Structures that are built perpendicular to the shore and extend into the water. Groins are generally constructed in series, referred to as a groin field, along the entire length of shore being protected. Groins trap sand in littoral drift and halt movement along beaches.

Groundskidding Practices: Practices to reduce the impacts of groundskidding including skidding uphill to log landings whenever possible, skidding with ends of logs raised to reduce rutting and gouging, skidding perpendicular to the slope (along the contour), and avoiding skidding on slopes greater than 40 percent.

Other practices include suspending groundskidding during wet periods, when excessive rutting and churning of the soil begins, or when runoff from skid trails is turbid and no longer infiltrates within a short distance from the skid trail. Installing waterbars or other erosion control and drainage devices, removing culverts, obliteration and revegetating serve to retire skid trails.

Habitat Assessment: Biological siting and design provisions for marinas based on the premise that marinas should not destroy important aquatic habitat, should not diminish the harvestability of organisms in adjacent habitats, and should accommodate the same biological uses (e.g., reproduction, migration) for which the source waters have been classified.

Habitat Restoration and Maintenance, Dams: Practices to manage or restore to

riparian habitat and water quality benefits. Examples of downstream aquatic habitat improvements include maintaining minimum instream flows, providing scouring flows when and where needed, providing alternative spawning areas or fish passage, protecting streambanks from erosion, and maintaining wetlands and riparian areas.

Hardened Channels: Channels with erosion-resistant linings of riprap, paving, or other structural material designed for the conveyance and safe disposal of excess water without erosion. Hardened channels replace grass-lined channels where conditions are unsuitable for the latter, such as steep slopes, prolonged flows, potential for traffic damage, erodible soils, or design velocity over 5 feet per second.

Harvesting Practices, Timber: Logging practices to protect the environment that include such things as falling trees away from watercourses, whenever possible; keeping logging debris from the channel, except where debris placement is specifically prescribed for fish or wildlife habitat; and immediately removing any tree accidentally felled in a waterway.

Harvest Planning, Timber: These practices consider potential water quality and habitat impacts when selecting the silviculture system as even-aged or uneven-aged, the yarding system, site preparation method, and any pesticides that will be used. Other practices include scheduling; minimizing soil disturbance and road damage; and providing special protection to sensitive habitat areas, streamside management areas, steep slopes, high-erosion-hazard areas, landslide prone areas, and wetlands.

Heavy Use Area Protection: Protecting heavily used areas by establishing vegetative cover, by surfacing with suitable materials, or by installing needed structures.

Holding Tanks: Holding tanks act as underground detention basins that capture and hold storm water until it can receive treatment. There are generally two classes of tanks: first flush tanks and settling tanks.

Household Hazardous Waste Collection: Household hazardous waste collection programs are when specific days are usually designated as drop-off days for collection of household hazardous waste and are advertised through television, newspapers, flyers, and radio.

Illegal Discharge Control: Control of any discharge to the storm drain system that is not entirely composed of storm water except discharges pursuant to a NPDES permit; discharges resulting from fire fighting activities; and discharges further exempted by a specific agency, municipality, or governmental ordinance.

Illicit Connection Control: Control of any physical connection to a publicly maintained storm drain system composed of non-storm water that has not been permitted by the public entity responsible for the operation and maintenance of the system.

Inactive Roads, Forest: Closing and stabilizing temporary spur roads and seasonal roads to control and direct water away from the roadway and removing all temporary stream crossings, following completion of harvesting.

Infiltration Basin/Trench: Infiltration practices suitable for storm water treatment include basins and trenches. Infiltration practices reduce runoff by increasing ground water recharge. Prior to infiltration, runoff is stored temporarily at the surface, in the case of infiltration basins, or in subsurface stone-filled trenches.

Inlet Protection: Temporary devices constructed around storm drain inlets to improve the quality of water being discharged to inlets or catch basins by ponding sediment-laden runoff and increasing settling time. Examples include block and gravel protection, excavated protection, sod protection, and fabric protection.

Instream Sediment Control: Instream sediment control uses several structural practices for streambank protection and channel stabilization. Practices include structures such as revetments, grade control structures, and flow restrictors to control bank erosion processes and streambed degradation. Channel stabilization structures are used to trap sediment and decrease the sediment delivery to desired areas by altering the transport capacity of the stream and creating sediment storage areas.

Integrative Ordinances: Water-related codes and ordinances, such as erosion and sediment controls, storm water management, and prevention of illicit connections, implemented through the site planning process and verified through the review process, that reduce development impacts.

Interceptor Trench: Used to interrupt long slope faces on gentle slopes (less than 3:1) and to allow diversion and infiltration of collected runoff and retention of sediment.

Irrigation Canal or Lateral: A permanent irrigation canal or lateral constructed to convey water from the source of supply to one or more farms. The conservation objectives are to prevent erosion or degradation of water quality or damage to land, to make possible proper water use, and to convey water efficiently to minimize conveyance losses.

Irrigation Field Ditch: A permanent irrigation ditch constructed to convey water from the source of supply to a field or fields in a farm distribution system.

Irrigation Land Leveling: Reshaping the surface of land to be irrigated to planned grades.

Irrigation Pit or Regulating Reservoir: A small storage reservoir constructed to regulate or store a supply of water for irrigation including pits if part of the water is impounded above natural ground, provided that the depth of water above the ground surface, as measured at the spillway crest elevation, does not exceed 3 feet. Also refers to reservoirs created by impounding structures and pits excavated below the ground surface for the short-period storage of either diverted surface water, water from pumped or flowing wells, or water from an irrigation delivery system.

Irrigation Storage Reservoir: An irrigation water storage structure made by constructing a dam designed to be filled during the season of low irrigation demand to provide water needed for irrigation during some other part of the year or in some future year.

Irrigation System, Microirrigation: A planned irrigation system in which all necessary facilities are installed for efficiently applying water directly to the root zone of plants by means of applicators (orifices, emitters, porous tubing, or perforated pipe) operated under low pressure.

Irrigation System, Sprinkler: A planned irrigation system in which all necessary facilities are installed for efficiently applying water by means of perforated pipes or nozzles operated under pressure.

Irrigation System, Surface and Subsurface: A planned irrigation system in which all necessary water control structures have been installed for efficient distribution of irrigation water by surface means, such as furrows, borders, contour levees, or contour ditches, or by subsurface means.

Irrigation System, Tailwater Recovery: A facility to collect, store, and transport irrigation tailwater for reuse in the farm irrigation distribution system.

Irrigation Water Conveyance: A fixed lining of impervious material installed in an existing or newly constructed irrigation field ditch, irrigation canal, or lateral.

Irrigation Water Management: Determining and controlling the rate, amount, and timing of irrigation water in a planned and efficient manner.

Joint Planting (Vegetated riprap): A bioengineering technique that involves tamping live cuttings of plant material into soil between the joints or open spaces in rocks that have previously been placed on a slope.

Land Smoothing: Removing irregularities on the land surface using special equipment and involving operations classed as rough grading.

Landing Practices: Practices to reduce the impact of timber harvesting by providing landings no larger than necessary and including drainage and erosion control structures as necessary. Upon completion of harvest, landings are cleaned up, re-graded, and re-vegetated.

Land Purchase and Development Rights: The purchase of land and/or development rights to that land is the best way to control activities within sensitive areas. Communities may purchase land outright or obtain conservation easements, which are voluntary arrangements preventing a landowner from

performing certain activities or prohibiting certain kinds or densities of development.

Land Use Prohibitions: Source-specific and chemical-specific standards that remove contamination sources from water supply areas by prohibiting or limiting the storage or use of large supplies of dangerous substances in sensitive areas.

Leak/Spill Prevention: Spill prevention and control practices to stop the source of a spill, contain the spill, clean up the spill, dispose of contaminated materials, and train personnel to prevent and control future spills.

Levee or Floodwall Setbacks: Siting of levees and floodwalls prior to design and implementation of these projects. Proper siting of such structures can avoid several types of problems such as construction activities disturbing the physical integrity of adjacent riparian areas and/or wetlands. In addition, by setting back the structures (offsetting them from the streambank), the relationship between the channel and adjacent riparian areas can be preserved.

Levee Protection: Techniques used to protect, operate, and maintain levees. Evaluation of site-specific conditions and the use of best professional judgment are the best methods for selecting the proper levee protection and operation and maintenance plan. Methods to control vegetation include mowing, grazing, burning, and using chemicals.

Level Spreader: An outlet designed to convert concentrated runoff to sheet flow and disperse it uniformly across a slope without causing erosion. This structure is particularly well-suited for returning natural sheet flows to exiting drainage that has been altered by development, especially for returning sheet flows to receiving ecosystems such as wetlands where dispersed flow may be important for maintain pre-existing hydrologic regimes.

Limited Surface Disturbance: Limiting the amount of bare soil to the minimum area required to conduct construction activities.

Lined Waterway or Outlet: A waterway or outlet having an erosion-resistant lining of concrete, stone, or other permanent material.

Liquid Material Practices: Practices for the proper storage, use, and disposal (and recycle when possible) of all liquid materials to prevent contact with storm water or discharge into storm drains and watercourses.

Litter and Debris Control: Controlling litter by encouraging businesses to keep the streets in front of their buildings free of litter; developing local ordinances restricting or prohibiting food establishments from using disposable food packaging, especially plastics, styrofoam, and other floatables; implementing "bottle bills" and mandatory recycling laws; providing technical and financial assistance for establishing and maintaining community waste collection programs; distributing public education materials on the benefits of recycling; and developing "user-friendly" ways for recycling, such as curbside pick-up, voluntary container buy-back systems, and drop-off recycling centers.

Live Cribwall: A bioengineering technique that consists of a hollow, box-like interlocking arrangement of untreated log or timber members. The structure is filled with suitable backfill material and layers of live branch cuttings, which root inside the crib structure and extend into the slope. Once the live cuttings root and become established, the subsequent vegetation gradually takes over the structural functions of the wood members.

Live Fascines: A bioengineering techniques using long bundles of branch cuttings bound together into sausage-like structures. When cut from appropriate species and properly installed, they will root and immediately begin to stabilize slopes.

Live Staking: A bioengineering technique that involves the insertion and tamping of live, rootable vegetative cuttings into the ground.

Log and Brush Check Dam: A sediment trap built of logs and brush.

Long-Term Inactive Roads, Forest: Procedures that control erosion, block vehicular traffic and remove bridges, culverts, ditches and unstable fills, as required on roads not intended to be used again in the near future but likely to be used again at some point in the future.

Low Impact Development (LID) Techniques: The principles of LID guide where to place development and how to build it to minimize

negative consequences for aquatic ecosystems. This is a site design strategy with a goal of maintaining or replicating the pre-development hydrologic regime through the use of design techniques to create a functionally equivalent hydrologic landscape.

Maintenance Facility Housekeeping Practices: Practices that reduce pollutants in storm water runoff by maintaining and washing equipment and machinery in confined areas specifically designed to control runoff; establishing fuel and vehicle maintenance staging areas located away from surface waters and all drainages leading to surface waters; and designing these areas to control runoff. Construction materials, refuse, garbage, sewage, debris, oil and other petroleum products, mineral salts, industrial chemicals, and topsoil are stored, covered, and isolated to prevent runoff of pollutants and contamination of ground water.

Maintenance of Revegetated Areas: Protective practices, irrigation, fencing, fertilization and repair practices for areas being revegetated.

Manure Transfer: A manure conveyance system using structures, conduits, or equipment to transfer animal manure (bedding material, spilled feed, process and wash water, and other residues associated with animal production may be included) through a hopper or reception pit, a pump (if applicable), and a conduit to a manure storage/treatment facility.

Marina Flushing: Siting and design marinas to reduce potential for water quality impacts. Selection of a site that has favorable hydrographic characteristics and requires the least amount of modification can reduce potential impacts.

Materials Management: Practices to prevent or reduce the discharge of pollutants to the environment from outdoor loading or unloading, outdoor container storage areas, and material handling.

Matting, Plastic: Plastic matting can be used for dust and erosion control during construction on bare soils.

Minimizing Directly Connected Impervious Areas (DCIAs): Disconnecting impervious surfaces and directing storm water runoff to landscaped areas, grass buffer strips, and vegetated swales to slow down the rate of runoff, reduce runoff volumes, attenuate peak flows, and encourage filtering and infiltration of storm water.

Mulching: A protective blanket of straw or other plant residue, gravel, or synthetic material applied to the soil surface to minimize raindrop impact energy and runoff, foster vegetative establishment, reduce evaporation, insulate the soil, and suppress weed growth.

Native Rock Retaining Wall: A low wall made from locally available rock used to stabilize steep slopes.

No-Wake Zones: Zones established for reducing the erosion potential of boat wakes on streambanks and shorelines. Posted speed limits on waterways generally restrict the movement of recreational boating traffic to speeds that reduce wave heights associated with wakes.

Nutrient Management: Managing the amount, source, placement, form and timing of the application of nutrients and soil amendments to budget and supply nutrients for plant production; to properly utilize manure or organic by-products as a plant nutrient source; to minimize agricultural polluted runoff of surface and ground water resources; and to maintain or improve the physical, chemical, and biological condition of soil.

Oil-Grit Separators: Oil-grit separators may be used to treat water from small areas where other practices are infeasible and are applicable where activities contribute large loads of grease, oil, mud, sand, and trash to runoff.

Oil-Water Separators: Structures designed to remove petroleum products from storm water by collecting the oil on the surface of the water while allowing the water to flow through.

Open Space Design: Open space design, also known as conservation development or cluster development, is a better site design technique that concentrates dwelling units in a compact area in one portion of the development site in

exchange for providing open space and natural areas elsewhere on the site.

Open-Top Box Culvert: A temporary or permanent drainage collection system. Should be used in conjunction with a silt fence and riprap.

Operational Procedures Adjustment, Dams: Improving the quality of reservoir releases through adjustments in the operational procedures at dams. These include scheduling releases or the duration of shutoff periods, instituting procedures for the maintenance of minimum flows, and making seasonal adjustments in the pool levels and in the timing and variation of the rate of drawdown.

Operation and Maintenance of Practices: Regular inspection of control practices to maintain the effectiveness. This also includes routine maintenance performed on a regular basis to keep structural practices in good working order and aesthetically pleasing.

Outdoor Loading/Unloading of Materials: Practices to limit the exposure of material to rainfall, prevent storm water run-on, require regular equipment checks for leaks, and contain spills during transfer operations.

Outdoor Process Equipment Operations and Maintenance: Practices that reduce the amount of waste created, enclose or cover all or some of the equipment, provide secondary containment and train employees.

Outdoor Storage of Raw Materials, Products, and By-Products: Practices to prevent or reduce the discharge of pollutants to storm water by enclosing or covering materials, installing secondary containment, and preventing storm water run-on.

Outlet Protection: A physical device composed of rock, grouted riprap, or concrete rubble that is placed at the outlet of a pipe to prevent scour of the soil caused by high pipe flow velocities, and to absorb flow energy to produce non-erosive velocities.

Outlet Stabilization Structure: A structure designed to control erosion at the outlet of a channel or conduit by reducing flow velocity and dissipating flow energy. This should be used where the discharge velocity of a structure exceeds the tolerances of the receiving channel or area.

Parking Lot Cleaning: This practice employs pavement cleaning practices such as sweeping on a regular basis to minimize pollutant export to receiving waters. These cleaning practices are designed to remove from road and parking lot surfaces sediment debris and other pollutants that are a potential source of pollution impacting urban waterways.

Pasture and Hayland Planting: Establishing and re-establishing long-term stands of adapted species of perennial, biannual, or reseeding forage plants. (Includes pasture and hayland renovation. Does not include grassed waterways, outlets, or cropland.)

Paved Flume: A small concrete-lined channel to convey water down a relatively steep slope without causing erosion. Flumes serve as stable, permanent elements of a storm water system receiving drainage from above a relatively steep slope, typically conveyed by diversions, channels, or natural drainage ways.

Perimeter Protection: Perimeter protection (silt fences) consists of geotextile material stretched and attached to supporting posts that assists in sediment containment on a site by capturing most of the eroded soil particles (sediment) and slowing the runoff velocity to allow particle settling.

Permanent Road Closure, Forest: Road closure, including removal of drainage structures, treatment of roadway sections and obliteration (or recontouring), so that erosion and landslides are minimized on roads not intended to be used again.

Pest Management: Utilizing environmentally sensitive prevention, avoidance, monitoring, and suppression strategies to manage weeds, insects, diseases, animals, and other organisms (including invasive and non-invasive species), that directly or indirectly causes damage or annoyance.

Petroleum Management Practices: Practices that reduce the potential for water contamination from petroleum products. Practices include servicing equipment where spilled fuel and oil cannot reach watercourses; draining all petroleum products and radiator water into containers; disposing of wastes and containers in accordance with proper waste disposal procedures; and taking precautions to prevent leakage and spills.

Pet Waste Management: Proper cleanup and disposal of canine fecal material and discouragement of public feeding of waterfowl to control the adverse impacts of animal droppings.

Pipeline: Pipeline installed for conveying water for livestock or for recreation.

Planned Grazing System: A practice in which two or more grazing units are alternately rested and grazed in a planned sequence for a period of years, and rest periods may be throughout the year or during the growing season of key plants.

Pole Culverts and/or Ditch Relief Culverts: Culverts are placed at varying intervals in a road to safely conduct water from the ditch to the outside portion of the road.

Pollution Prevention for Businesses: Pollution prevention (P2) is the combination of activities that reduce or eliminate the amount of chemical contaminants at the source of production or prevent this waste from entering the environment or waste stream. This occurs when raw materials, water energy, and other resources are used more efficiently; when less harmful substances are substituted for hazardous ones; and when toxic substances are eliminated from the production process.

Polyacrylamide (PAM) Erosion Control: Erosion control through application of water-soluble anionic polyacrylamide . This practice is applied as part of a conservation management system to minimize or control irrigation-induced soil erosion or to reduce wind and/or precipitation erosion.

Pond: A water impoundment made by constructing an embankment or by excavating a pit or dugout.

Pond Seal and Liner: A liner for a pond or waste impoundment to reduce seepage losses from ponds or waste impoundments for water conservation and environmental protection.

Porous Pavement: Porous pavement has a layer of porous top course covering an additional layer of gravel. A crushed stone-filled ground water recharge bed is typically installed beneath these top layers.

Portable Systems, Sewage: Portable/mobile systems are similar to fixed-point systems and in some situations may be used in their place at a fueling dock. The portable unit includes a pump and a small storage tank connected to the deck fitting on the vessel, and wastewater is pumped from the vessel's holding tank to the pumping unit's storage tank. When the storage tank is full, its contents are discharged into a municipal sewage system or a holding tank for removal by a septic tank pumpout service.

Preharvest Notification: Notification of the Idaho Department of Lands before commencing a forest practice or a conversion of forestlands.

Prescribed Burning: Applying fire to predetermined areas during conditions under which the intensity and spread of the fire can be controlled.

Prescribed Fire Practices: Carefully planned burning to adhere to weather, time of year, and fuel conditions that will help achieve the desired results and minimize impacts on water quality.

Prescribed Grazing: Managing the controlled harvest of vegetation with grazing animals.

Preservation of Existing Vegetation: Designating areas for protection to minimize the potential of removing or injuring existing trees and other vegetation that serve as erosion controls.

Product Storage, Use and Handling: A source control to prevent the release of a chemical product by storing properly, and following the manufacturer's directions

Proper Grazing Use: Grazing at an intensity that will maintain enough cover to protect the soil and maintain or improve the quantity and quality of desirable vegetation.

Proper Woodland Grazing: Grazing wooded areas at an intensity that will maintain adequate cover for soil protection and maintain or improve the quantity and quality of trees and forage vegetation.

Public Education: Public education explains how businesses and households can protect water quality. Topics include environmentally responsible landscaping and lawn care, safe

use of chemicals, care of septic systems, and water conservation techniques.

Public Health Regulations: A local health district can help protect source waters by prohibiting or registering residential underground storage tanks, testing for leaks, instituting ground water monitoring and construction standards, restricting the number and size of septic systems allowed in an area; and prohibiting floor drains that discharge to ground water.

Public Participation/Public Involvement: Including the public in developing, implementing, and reviewing water quality management programs. Opportunities for members of the public to participate in program development and implementation include serving as citizen representatives on local panels, attending public hearings, working as citizen volunteers to educate other individuals about programs, assisting in program coordination with other pre-existing programs, and participating in volunteer monitoring efforts.

Pumping Plant for Water Control: A pumping facility installed to transfer water for a conservation need, including removing excess surface or ground water; filling ponds, ditches or wetlands; or pumping from wells, ponds, streams, and other sources. This water can provide a dependable water source or disposal facility for water management on wetlands or provide a water supply for such purposes as irrigation, recreation, livestock, or wildlife.

Range Seeding: Establishing adapted plants by seeding on native grazing land. (Range does not include pasture and hayland planting.)

Reclamation, Mining: Erosion and pollution from mine tailings are minimized through land reclamation. Tailings are modified and/or isolated from the surrounding environment. Modification happens through leaching, amendment applications, and biological treatment. Isolation involves separation of tailings from potential receiving waters and can include construction of barriers and depth isolation.

Regeneration Practices: Reforestation practices that protect water quality by distributing seedlings evenly across a site; hand planting highly erodible sites, steep slopes, and lands adjacent to stream channels; and operating planting machines along the contour to avoid ditch formation.

Repair Leaking Sewer Lines: The detection and elimination of sanitary sewer leaks into the storm drain system.

Reregulation Weir: Used to establish minimum flows for preservation of instream habitat. This device is installed in the streambed a short distance below a dam and captures hydropower releases. Flows through the weir can be regulated to produce the desired conditions of water level and flow velocities that are best for instream habitat.

Residual Stocking: Live trees left standing after the completion of harvesting to maintain the continuous growing and harvesting of forest tree species.

Residue Management: Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round, while growing crops where the entire field surface is tilled prior to planting.

Restrict Timing of Activity, Hydromodification: Restricting the timing of hydromodification activities is targeted at reducing sediment yield and direct disturbance to fish during sensitive life stages such as spawning and rearing.

Retention Pond: A pond designed to capture and retain runoff from frequently occurring storms.

Return Walls: Return walls are used at either end of a vertical protective structure such as a bulkhead or revetment to prevent flanking. Flanking occurs when waves dislodge the substrate at both ends of the structure, resulting in very concentrated erosion and rapid loss of fastland. The walls should extend landward for a horizontal distance consistent with the local erosion rate and the design life of the structure.

Revegetation of Disturbed Areas: Planting practices that include using seed mixtures adapted to the site; using native woody plants planted in rows, cordons, or wattles on steep slopes; seeding during optimum periods for establishment, preferably just prior to fall rains; mulching as needed to hold seed, retard rainfall impact, and preserve soil moisture;

fertilizing according to site-specific conditions, and protecting seeded areas from grazing and vehicle damage until plants are well established.

Revetment: A type of vertical protective structure used for shoreline protection. One revetment design contains several layers of randomly shaped and randomly placed stones, protected with several layers of selected armor units or quarry stone. Sometimes gabions (stone-filled wire baskets) or interlocking blocks of pre-cast concrete are used in the construction of revetments.

Rigid Channel Liner: A non-erosive structure or surface placed in a channel or ditch. Rigid channel liners may be used to prevent erosion resulting from high velocities of water.

Riparian Area Management: Practices to manage or restore to riparian habitat and water quality benefits. Examples of downstream aquatic habitat improvements include maintaining minimum instream flows, providing scouring flows when and where needed, providing alternative spawning areas for fish passage, protecting streambanks from erosion, and maintaining wetlands and riparian areas.

Riparian Forest Buffer: An area of predominantly trees and/or shrubs located adjacent to and up gradient from watercourses or waterbodies.

Riprap: A layer of stone designed to protect and stabilize areas subject to erosion, slopes subject to seepage, or areas with poor soil structure. Riprap is used on slopes where vegetation cannot be established, channel slopes and bottoms, storm water structure inlets and outlets, slope drains, streambanks, and shorelines.

Road Outsloping and Grading: Roadbeds are graded and outsloped to minimize water accumulation on road surfaces. This practice minimizes erosion and road failure potential. Outsloping involves grading the road so that it slopes downward from the toe of the road cut to the shoulder.

Road Runoff Collection and Conveyance Practices: Practices used to intercept and collect runoff while minimizing erosion and providing a conduit to convey the water to a desired runoff point. Examples include berms, diversion dikes, culverts, ditches, inlets spillways, and waterbars.

Road Runoff Dispersion and Dissipation Practices: Practices used to convert high velocity flows to lower velocity flows. Examples include benches, check dams, slope drains, and energy dissipators.

Road Inspection: Inspection of roads to determine the need for structural maintenance.

Road Maintenance: Conducting maintenance practices, when conditions warrant, including cleaning and replacing deteriorated structures and erosion controls, grading or seeding of road surfaces, and, in extreme cases, stabilizing slopes or removing road fills where necessary to maintain structural integrity.

Road Sloping: Selectively constructing or grading a road surface to direct surface water runoff in a desired direction, usually to the outside of the road.

Road System Planning: A group of practices designed to avoid sensitive areas, minimize total mileage, reduce grades, and minimize impacts to streams.

Roadway Surface Water Deflectors: A runoff interceptor built of treated wood and conveyor belt. The deflector is installed across the roadbed to convey surface water off the roadbed.

Rolling Dips: Structures that are designed into a road surface when it is being surveyed that are intended to divert water off the road surface. Rolling dips are the result of gradual grade changes along a length of road.

Roof Runoff Structure: A facility for controlling and disposing of runoff water from roofs.

Runoff Controls: Includes various practices designed to keep water from coming in contact with bare soil or controlling its velocity if it does. Included are drains for surface and subsurface water, dikes and swales placed across slopes to interrupt runoff, and roughness created on the surface to reduce velocity.

Runoff Diversions: Structures that channel upslope runoff away from erosion source areas, divert sediment-laden runoff to appropriate traps or stable outlets, or capture runoff before it leaves the site, diverting it to

locations where it can be used or released without erosion or flood damage. Diversions include graded surfaces to redirect sheet flow, diversion dikes or berms that force sheet flow around a protected area, and storm water conveyances (swales, channels, gutters, drains, sewers) that intercept, collect, and redirect runoff.

Sand Filter: Sand filters (also known as filtration basins) consist of layers of sand of varying grain sizes (grading from coarse sand to fine sands or peat), with an underlying gravel bed for infiltration or perforated underdrains for discharge of treated water.

Sanitary Sewer Hookup: Providing sanitary sewer hookups for residences that have failing septic systems, and in situations when inside floor drains are inappropriately connected to the storm drain system.

Scheduling: Sequencing a construction project to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff, and vehicle tracking.

School-Age Educational Programs: School curricula on watershed protection, including nonpoint pollution control, developed for elementary and secondary school education programs.

Sediment Basins: Basins constructed to collect and store debris or sediment.

Sediment Basin/Rock Dam: An earthen or rock embankment located to capture sediment from runoff and retain it on the construction site, for use where other on-site erosion control practices are not adequate to prevent off-site sedimentation. Sediment basins are more permanent in nature than sediment traps, and can be designed as permanent features of a development. Basins are most commonly used at the outlets of diversions, channels, slope drains, or other runoff conveyances that discharge sediment-laden water.

Sediment Collection: Collection of sediment using barriers such as filter fabric, straw bale fences, brush fences, and barriers constructed of gravel; and settling ponds.

Sediment Fence (Silt Fence)/ Straw Bale Barrier: A temporary sediment barrier designed to retain sediment from small disturbed areas by reducing the velocity of sheet flows. The barrier can consist of filter fabric buried at the bottom, stretched, and supported by posts; or straw bales staked into the ground.

Sediment Trap: A small, temporary ponding basin formed by an embankment or excavation to capture sediment from runoff. Traps are most commonly used at the outlets of diversions, channels, slope drains, or other runoff conveyances that discharge sediment-laden water.

Seedbed Preparation: Preparation of the soil surface to provide better plant growth conditions prior to seeding.

Septic System Design and Construction: Sizing, pretreatment, and installation practices for on-site wastewater treatment systems.

Septic System Operation and Maintenance: Practices for proper operation and maintenance of a septic system including water conservation to avoid hydraulic overloading, avoiding disposal of household chemicals in the system, and regular inspection and pumping.

Serrated Slopes: Small steps on a slope face that provides favorable sites for establishing vegetation and controlling runoff. This method is limited to soils that have medium to high cohesion properties.

Setbacks: Restrictions on the siting and construction of new standing structures along a shoreline.

Sewage Facility Maintenance: Practices to ensure that sewage pumpout facilities are used at marinas and are maintained in operational condition.

Sewage Facility Practices: Practices used at marinas to prevent water pollution that include the installation of pumpout, dump station, and restroom facilities where needed at new and expanding marinas to reduce the release of sewage to surface waters.

Shoreline Stabilization: Using vegetation or structures to stabilize and protect banks of streams, lakes, estuaries, or excavated channels against scour and erosion.

Sills: The purpose of a sill is to halt the upstream movement of a headcut, thus precluding the widening or deepening of the existing channel. A sill is constructed in the same manner as a drop structure.

Siltation Berm: A temporary impermeable berm for use on construction sites to retain runoff water on site.

Silt Fences: Silt fences are temporary barriers used to intercept sediment- laden runoff from small areas. They act as a strainer: silt and sand are trapped on the surface of the fence while water passes through. They may consist of woven geotextile filter fabric or straw bales.

Site-Based Local Controls: Natural drainage techniques that rely on the use of small-scale, distributed, microcontrol systems to replicate the natural hydrology of a site.

Site Plan Review Procedures: A site plan review involves review of specific development proposals for consistency with the laws and regulations of the local government of jurisdiction.

Site Preparation Practices, Reforestation: A silviculture activity to remove unwanted vegetation and other material, and to cultivate or prepare the soil for regeneration by seeding, planting, or from sprouts. It is accomplished mechanically using wheeled or tracked machinery, by the use of prescribed burning, or with applications of chemicals.

Siting Criteria, Septic Systems: Siting criteria include minimum horizontal and vertical setback distances and criteria for soil permeability.

Slash Filter Fence: A sediment trap built of windrowed slash.

Slope Drain: A temporary pipe or lined channel used to drain the top of a slope to a stable discharge point at the bottom of a slope.

Slope Roughening: Slope roughening/ terracing creates uneven depressions, steps, or grooves on the soil surface for establishing vegetation, reducing runoff velocity, increasing infiltration, and providing small depressions for trapping sediment.

Sluicing: The practice of releasing water through a sluice gate rather than through turbines in a dam. For portions of the waterway immediately below the dam, the steady release of water by sluicing provides minimum flows with the least amount of water expenditure.

Small Turbines: Small turbines are used to provide continuous generation of power using small flows, as opposed to operating large turbines using high flows.

Snow Removal/De-icing: Snow/ice removal consists of plowing snow and ice from bridges, roadways, and shoulders. Sanding activities put sand on road and bridge surfaces to provide for safer driving surfaces. Anti-icers are applied to prevent water from bonding to the pavement.

Sodding: Providing permanent stabilization of exposed areas by laying a continuous cover of grass sod. Sod is useful for providing immediate cover in steep critical areas and in areas unsuitable for seed, such as flow ways and around inlets.

Soil and Crop Water Use Data: Soils information used to determine the available water-holding capacity of the soil along with the amount of water that the plant can extract from the soil before additional irrigation is needed.

Soil Protection, Timber Harvesting: Selection of the logging method and type of equipment adapted to the given slope, landscape, and soil properties in order to minimize soil erosion.

Soil Stabilization: The proper placing, grading, and /or covering of soil, rock, or earth to ensure its resistance to erosion, sliding, or other movement.

Solid Waste Practices: Practices to prevent or reduce the discharge of pollutants to the environment from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.

Source Controls: Management practices or structural practices that work at the source to prevent sediment or pollutants from entering storm water runoff.

Spill Contingency Plan: A plan to prevent or reduce the discharge of pollutants to the environment from leaks and spills.

Spill Prevention and Control: Preventing or reducing the discharge of pollutants to storm water from accidental spills by preventing spills and leaks, quickly responding to control the spill, and conducting appropriate and thorough cleanups.

Spoil Spreading: Disposing of surplus excavated materials by placing it in surface depressions; by shaping; by spreading it over the surface of adjacent lands along the ditch, canal, or other excavations from which the spoil was removed; or by placing it on other specified areas.

Spring Development: Improving springs and seeps by excavating, cleaning, capping, or providing collection and storage facilities.

Staging and Materials Site Management: Locating, constructing and maintaining staging and storage areas within or adjacent to construction sites so that no contaminated storm water or wind erosion (dust) is discharged from the site.

Stock Trails and Walkways: Travel facilities for livestock and/or wildlife to provide movement through difficult or ecologically sensitive terrain to provide or improve access to forage, water and/or shelter; improve grazing efficiency and distribution, or divert travel away from ecologically sensitive and/or erosive sites.

Storm Drain Inspection and Maintenance: The inspection and maintenance (including repair, replacement, and clearing of pipes, culverts, underdrains, horizontal drains, and other elements) of storm water drainage systems. This also includes the cleanout of inlets, catch basins, and manholes using a vacuum truck and the removal of silt, debris, and overgrown vegetation to maintain the flood control capacity of drainage ditches.

Storm Drain Stenciling: Marking storm drains using stenciling to reduce illegal dumping of litter, leaves, and toxic substances down urban runoff drainage systems. These programs serve as educational reminders to the public that such storm drains often discharge untreated runoff directly to rivers or lakes.

Storm Drain System Operation and Maintenance: Proper operation and maintenance of structural treatment facilities is critical to their effectiveness in mitigating adverse impacts of urban runoff.

Storm Water Controls: Source controls and structural facilities used to control storm water runoff. Structural facilities include sand filters, ponds, wetlands, infiltration basins and trenches, chemical and filtration treatment systems, vegetated filter strips and grassed swales, porous pavement, oil-grit separators, catch basins, absorbents in drain inlets, holding tanks and swirl concentrators. Source controls are management practices or structural practices that work at the source to prevent sediment or pollutants from entering storm water runoff.

Storm Water System Retrofitting: The creation or modification of an urban runoff management system in a previously developed area. This may include using wet ponds, infiltration systems, wetland plantings, streambank stabilization, and other techniques for improving water quality and creating aquatic habitat. A retrofit can consist of the construction of a new practice in a developed area, the enhancement of an older urban runoff management structure, or a combination of improvement and new construction.

Straw Bale Barrier: A series of secured anchored straw bales paced end to end along a level contour in a shallow trench to intercept sediment-laden runoff from small drainage areas of disturbed soil.

Streambank Protection: Streambank protection may involve the use of several techniques and materials. Management practices for the prevention of streambank failures include protection of existing vegetation along streambanks; regulation of irrigation near streambanks and rerouting of overbank drainage; and minimization of loads on top of streambanks (such as prevention of building within a defined distance from the streambed).

Streambank Stabilization: Techniques for controlling erosion including wetland creation and vegetative bank stabilization.

Streambank/Shoreline Stabilization, Structural: Structural shore or streambank erosion control methods such as returns or

return walls, toe protection, and proper maintenance or total replacements.

Stream Channel Stabilization: Stabilizing the channel of a stream with suitable structures to control aggradation or degradation in a stream channel. This does not include work done to prevent bank cutting or meandering.

Stream Crossings: A temporary stream crossing (a bridge or culvert) provides a means for construction vehicles to cross streams or watercourses without damaging the streambed or channel, and protects the streambank from further degradation and sediment loss. In some circumstances fords may result in less disturbance to streams and fisheries than installing culverts.

Stream Habitat Improvement and Management: Strategies to maintain, improve, or restore physical, chemical and biological functions of a stream.

Streamside Management Areas: Streamside areas with a minimum width of 30-50 feet where soil disturbance and chemical use is minimized; and landings, roads, mechanical site preparation, and tree harvesting are restricted.

Street Sweeping and Vacuuming: Pavement cleaning practices using street sweeping on a regular basis to minimize pollutant export to receiving waters. These cleaning practices are designed to remove sediment, debris, and other pollutants that are a potential source of pollution.

Stripcropping, Contour: Growing crops in a systematic arrangement of strips or bands across the general slope to reduce water erosion. The crops are arranged so that a strip of grass or a close-growing crop is alternated with a clean-tilled crop or fallow.

Stripcropping, Field: Growing crops in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion. The crops are arranged so that a strip of grass or a close-growing crop is alternated with a clean-tilled crop or fallow.

Structural Treatment Practices, Storm Water: Structures used to control runoff or temporarily store storm water on site. A number of structural devices have been developed to encourage filtration, infiltration, or setting of suspended particles.

Structure for Water Control: A structure in an irrigation, drainage, or other water management system that conveys water, controls the direction or rate of flow, or maintains a desired water surface elevation.

Subdivision Growth Controls: Subdivision regulations that govern the process by which individual lots of land are created out of larger tracts. Subdivision regulations are intended to ensure that subdivisions are appropriately related to their surroundings. The primary purpose is to control division of land into lots suitable for building. This measure can protect drinking water supplies from septic system effluent and storm water runoff.

Subsurface Drain: A conduit, such as corrugated plastic tile or pipe, installed beneath the ground surface to collect and/or convey drainage water.

Surface Drainage, Field Ditch: A graded ditch for collecting excess water in a field.

Subsurface Drainage, Main or Lateral: An open drainage ditch constructed to a designed size and grade for disposal of surface and subsurface drainage water primarily collected by drainage field ditches and subsurface drains.

Surface Roughening: Roughening a bare, sloped soil surface with horizontal grooves or benches running across the slope. Grooves can be large-scale, such as stair-step grading with small benches or terraces, or small-scale, such as grooving with disks, tillers, or other machinery. Heavy tracked machinery which should be reserved for sandy, non-compressible soils.

Swirl Concentrator: A swirl concentrator is a small, compact solids separation device with no moving parts. During wet weather the unit's outflow is throttled, causing the unit to fill and to self-induce a swirling vortex. Secondary flow currents rapidly separate first flush settleable grit and floatable matter.

Temporary Block and Gravel Inlet Protection: A temporary sediment control barrier formed around a storm drain inlet by the use of standard concrete block and gravel to filter sediment from storm water entering the inlet prior to stabilization of the

contributing area soils, while allowing use of the inlet for storm water conveyance.

Temporary Excavated Drop Inlet Protection: A temporary excavated area around a storm drain drop inlet or curb inlet designed to trap sediment prior to discharge into the inlet.

Temporary Fabric Drop Inlet Protection: A temporary fabric barrier placed around a drop inlet to help prevent sediment from entering storm drains during construction operations, while allowing use of the inlet for storm water conveyance.

Temporary Gravel Construction Access: A graveled area or pad located at points where vehicles enter and leave a construction site. This practice provides a buffer area where vehicles can drop their mud and sediment to avoid transporting it onto public roads, to control erosion from surface runoff, and to help control dust.

Temporary and Permanent Seeding: Temporary seeding involves planting rapid-growing annual grasses, small grains, or legumes to provide initial, temporary stabilization to minimize runoff, erosion, and sediment yield on disturbed soils that will not be brought to final grade for more than approximately one month. Fertilizing and surface roughening facilitate seeding.

Temporary Roads/Entrances: Implementing practices to control erosion and sedimentation originating from haul roads, detours, access roads (paved/unpaved), construction entrances/exits, and access roads to sensitive areas associated with a construction project.

Temporary Slope Drain: Flexible tubing or conduit extending temporarily from the top to the bottom of a cut or fill slope for the purpose of conveying concentrated runoff down the slope face without causing erosion.

Temporary Sod Drop Inlet Protection: A permanent grass sod sediment filter area around a storm drain drop inlet for use once the contributing area soils are stabilized.

Temporary Stream Crossing: A bridge, ford, or temporary structure installed across a stream or water course for short-term use by construction vehicles or heavy equipment, intended to keep sediment out of the stream and avoid damage to the streambed.

Terrace: An earthen embankment, channel, or combination ridge and channel constructed across a slope.

Timing of Construction and Control Applications: The sequence of construction activities and erosion control application to minimize erosion created by construction disturbance.

Toe Protection: Toe protection usually takes the form of a stone apron installed at the base of the vertical structure to reduce wave reflection and scour of bottom sediments during storms.

Topsoiling: Preserving and subsequently using the upper, biologically active layer of soil to enhance final site stabilization with vegetation.

Tree/Shrub Establishment: Establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.

Turbine Pulsing: A practice involving the release of water through the turbines at regular intervals to improve minimum flows.

Turbine Venting: The practice of injecting air into water as it passes through a turbine.

Underground Outlet: A conduit installed beneath the surface of the ground to collect excess surface water from terraces, diversions, subsurface drains, surface drains, trickle tubes, or other areas which concentrate surface water, and convey it to a suitable outlet to dispose of without causing damage by erosion or flooding.

Upland Wildlife Habitat Management: Creating, restoring, maintaining or enhancing areas for food, cover, and water for upland wildlife and species that use upland habitat for a portion of their life cycle.

Urban Forestry: Increasing the urban forest through tree-planting programs. Planting trees where none exist reduces runoff through interception of precipitation, moderates urban climate, improves air quality, and reduces noise. Trees and other vegetation can be incorporated into community open space,

street rights-of-way, parking lot islands, and other landscaped areas.

Use Exclusion: Excluding animals, people, or vehicles from an area by preventing, restricting, or controlling access to the area to maintain or improve the quantity and quality of natural resources or minimize liability and human health concerns.

Vegetated Filter Strip (VFS): A low-gradient vegetated area that filters solids from overland sheet flow. A VFS can be natural or planted; should have relatively flat slopes; and should be vegetated with dense-culmed, herbaceous, erosion-resistant plant species.

Vegetation Control: Vegetation maintenance compatible with environment, aesthetics, erosion, and dust control through chemical weed control, mechanical weed control, tree and shrub pruning, and tree and shrub removal.

Vegetation/Seeding: The process of growing, from seed, a vegetative cover on disturbed areas to control erosion during construction and to stabilize slopes and surface areas.

Vegetative Practices: Use of vegetation to filter contaminants or promote infiltration of wastewater. Practices include using constructed wetlands, vegetated buffer strips, grassed swales, or depressions that collect runoff.

Vegetation/Planting: Permanent vegetation/planting through the process of using live plants, plant parts, roots, or cut sod for long-term or permanent vegetative cover on disturbed areas or areas that need additional assistance for soil/slope stabilization and erosion control.

Vehicle and Equipment Fueling Practices: Practices to prevent fuel spills and leaks through facility design, spill control, and designated fueling areas.

Vehicle and Equipment Maintenance Practices: Practices that prevent or reduce the discharge of pollutants to the environment from vehicle and equipment maintenance and repair by running a dry shop.

Waste Handling and Disposal: Preventing or reducing the discharge of pollutants to storm water from waste handling and disposal by tracking waste generation, storage, and disposal; reducing waste generation and disposal through source reduction, reuse, and recycling; and preventing run-on and runoff from waste management areas.

Waste Management System: A planned system in which all necessary components are installed for managing liquid and solid waste, including runoff from concentrated waste areas, in a manner that does not degrade air, soil, or water resources.

Waste Materials Treatment, Timber: The practice of placing all debris, overburden, and other waste materials associated with harvesting in such a manner as to prevent their entry by erosion, high water, or other means into streams.

Waste Storage Pond: A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure to temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system.

Waste Storage Facility: A fabricated structure for temporary storage of animal wastes or other organic agricultural wastes.

Waste Treatment Lagoon: An impoundment made by excavation or earth fill for biological treatment of animal or other agricultural wastes.

Waste Utilization: Using agricultural wastes or other wastes on land in an environmentally acceptable manner while maintaining or improving soil and plant resources.

Waterbar: A berm constructed across a roadway to divert storm runoff away from unpaved surfaces or other disturbed areas.

Water Harvesting Catchment: A facility for collecting and storing precipitation created by sealing a portion of a watershed or contributing areas to increase, collect, and store runoff water for future use. This also includes simple curbs and diversions constructed to collect and store runoff from such high runoff areas as rock outcrops or existing paved or impervious areas.

Water and Sediment Control Basin: An earthen embankment or a combination ridge

and channel generally constructed across a slope and minor watercourse to form a sediment trap and water detention basin.

Watering Facility: A device (tank, trough, or other watertight container) for providing animal access to water.

Water-Measuring Device: An irrigation water meter, flume, weir, or other device installed in a pipeline or ditch to measure water flow.

Water Quality Assessment: An assessment of water quality as part of marina siting and design.

Water Well: A hole drilled, dug, driven, bored, jetted or otherwise constructed to an aquifer to provide water for livestock, wildlife, irrigation, human, and other uses.

Watershed Practices: Management of pollution sources from a watershed. Practices for watershed management include land use planning, erosion control, ground water protection, mine reclamation, pollutant screening and identification, animal waste control, and failing septic tank control.

Water Table Control: Controlling the water table through proper use of subsurface drains, water control structures, and water conveyance facilities for the efficient removal of water or runoff.

Well Decommissioning: The sealing and permanent closure of a water well no longer in use.

Wetland and Riparian Zone Protection: The protection and restoration of wetlands and riparian areas, wherever possible. Replanting the banks and floodplains of a stream with native species to stabilize erodible soils and improve surface water and ground water quality can also restore riparian forests.

Wetland Development or Restoration: The construction or restoration of a wetland facility to provide the hydrological and biological benefits of a wetland for wildlife, to reduce flooding, provide offsite water quality benefits, and provide ground water recharge of acceptable water quality.

Wetland Restoration: A rehabilitation of a drained or degraded wetland where the soils, hydrology, vegetative community, and biological habitat are returned to the natural condition to the extent practicable.

Wetland Wildlife Habitat Management: Retaining, developing, or managing habitat for wetland wildlife.

Wet Pond: A basin designed to maintain a permanent pool of water and temporary storage capacity for storm water runoff. The permanent pool enhances pollutant removal by promoting the settling of particulates, chemical coagulation and precipitation, and biological uptake of pollutants. It is normally 0.5 to 1 inch in depth per impervious acre.

Wildfire Practices: Practices used when combating wildfires to reduce impacts to watercourses. These practices include avoiding the use of fire-retardant chemicals in streamside areas and over watercourses and preventing runoff into watercourses. Application equipment should not be cleaned in watercourses or locations that drain into watercourses. Fire suppression components such as firelines, staging areas, helispots and camps should be properly located, designed and closed. Advance planning and training for firefighters to consider water quality impacts when fighting wildfires should be provided.

Winter Harvesting Practices, Timber: Drainage and maintenance practices that address the risk of erosion and damage from winter logging operations. When properly sited and conducted, winter harvesting can result in less soil disturbance.

Winter Operation Practices, Forest Roads: Drainage and maintenance practices that address the risk of erosion and damage from roads and skid trails from winter logging operations.

Zoning: The division of a municipality or county into districts fro the purpose of regulating land use. Communities traditionally use zoning to separate potentially conflicting land uses from one another.

APPENDIX B

Additional Information

AGRICULTURE

Idaho Department of Agriculture, Agricultural Water Quality Program, web site at **http://www.agri.state.id.us/gw/WaResTOC.htm**.

Idaho One Plan, a catalog of best management practices retrieved at **http://www.oneplan.org**.

U. S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), *Comprehensive Nutrient Management Planning – Technical Guidance*, retrieved at **http://www.nrcs.usda.gov/technical/nutrient.html**.

USDA NRCS *National Handbook of Conversation Practices*, retrieved at **http://www.ftw.nrcs.usda.gov/nhcp_2.html**.

United States Environmental Protection Agency (USEPA), Office of Water, Management Practices to Control Nonpoint Sources Pollution from Agriculture retrieved at **http://www.epa.gov/owow/nps/agmm/**

SILVICULTURE

USEPA Office of Water, *National Management Practices to Control Polluted Runoff from Forestry* retrieved at **http://www.epa.gov/owow/nps/forestrymgmt**.

USEPA, *Management Practices for Forestry* retrieved at **http://www.epa.gov/owow/nps/MMGI/Chapter3/index.html**.

Idaho Department of Lands (IDL), Forester Forums accessed at **http://www.deq.state.id.us/lands/Bureau/ForestAssist/state_forester_forum.htm**.

IDL, *Idaho Administrative Code, Rules Pertaining to the Idaho Forest Practices Act*, retrieved at **http://www3.state.id.us/idstat/TOC/idstTOC.html**.

Seyedbagheri, Kathleen A. 1992. *Forest Practices BMP Effectiveness.* UDDA Forest Service Intermountain Research Station, for the Idaho Department of Health and Welfare, Division of Environmental Quality (Collection Agreement INT-9084-CA).

USDA Forest Service, Regions 1 and 4. 1988. *Soil and Water Conservation Practices Handbook*. Forest Service Handbook 2509.22.

HYDROLOGIC MODIFICATION

USDA NRCS, *Stream Corridor Restoration: Principles, Process and Practices* retrieved at **http://www.usda.gov/stream_restoration/newgra.html**.

USEPA, *National Management Practices to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Sources Pollution* retrieved at **http://www.epa.gov/owow/nps/wetpractices/**.

Idaho Department of Water Resources, *Idaho Administrative Code, Rules and Minimum Standards for Stream Channel Alterations* retrieved at **http://www.deq.state.id.us/adm/adminrules/rules/idapa37/0307.pdf**.

MINING

IDL, Best Management Practices for Mining in Idaho.

IDL, *Idaho Administrative Code, Rules Governing Exploration and Surface Mining Operations in Idaho* retrieved at **http://www.deq.state.id.us/adm/adminrules/rules/idapa20/0302.pdf**.

IDL, *Idaho Administrative Code, Rules Governing Placer and Dredge Mining Operations in Idaho* retrieved at **http://www.deq.state.id.us/adm/adminrules/rules/idapa20/0301.pdf**.

Norman, David K., P. Wampler, A. Throop, E. Schmitzer and J. Roloff, 1997. *Best Management Practices for Reclaiming Surface Mines in Oregon and Washington* at **http://www.wa.gov/dnr/htdocs/ger/pdf/bmp.pdf**.

Pennsylvania State University, *WATERSHEDS, A Decision Support System for Nonpoint Source Pollution Control* retrieved at **http://h2osparc.wq.ncsu.edu/**.

URBAN ACTIVITIES/STORM WATER RUNOFF

Department of Environmental Quality 2001, *Catalog of Stormwater BMPs for Idaho Cities and Counties.*

Department of Environmental Quality 1997, *Environmental Planning Tools and Techniques,* retrieved at **http://www.deq.state.id.us/water/gw/env_planning_tools_report.htm.**

USEPA, Fact sheets and outreach materials retrieved at **http://cfpub.epa.gov/npdes/pubs.cfm?program_id=6**.

USEPA, Urban nonpoint source control information retrieved at **http://www.epa.gov/owow/nps/urban.html**.

Stormwater Center at **http://www.stormwatercenter.net**.

ON-SITE DISPOSAL SYSTEMS

National Small Flows Clearinghouse, An excellent reference for the most complete and current information on management options for septic systems at **http://www.nesc.wvu.edu/nsfc/nsfc_index.htm**.

DEQ, *A Homeowner's Guide to Septic Systems* retrieved at **http://www.deq.state.id.us/deq/water/gw/septicsystem_brochure.htm** .

University of Idaho, College of Agriculture, Cooperative Extension System, *Care and Maintenance of Your Home Septic System* retrieved at **http://info.ag.uidaho.edu/Resources/PDFs/CIS1027.pdf**.

Septic Information Website, *Inspecting, Designing, & Maintaining Residential Septic Systems* retrieved at **http://www.inspect-ny.com/septbook.htm**.

USEPA, *Design Manual for Onsite Wastewater Treatment and Disposal Systems* (1980), currently under revision.

TRANSPORTATION

Idaho Transportation Department, *Erosion and Sediment Control*, January 2002.

IDL, *Best Management Practices for Road Activities.*

California Department of Transportation, *Transportation Water Pollution Control Manual* retrieved at **http://www.dot.ca.gov/hq/traffops/developserv/permits/water_pollution_control/manual.html**.

Washington State Department of Transportation, *Highway Runoff Manual* retrieved at **http://www.wsdot.wa.gov/eesc/environmental/programs/hazwqec/wqec_docs.htm.**

USEPA, nonpoint source pollution control information accessed at **http://www.epa.gov/owow/nps/roadshwys.html**.

MARINAS AND RECREATIONAL BOATING

USEPA, *National Management Practices to Control Nonpoint Source Pollution from Marinas and Recreational Boating*, retrieved at **http://www.epa.gov/owow/nps/mmsp/index.html**.

APPENDIX C

Contact Information

California Department of Transportation
Caltrans Public Affairs Office
Jim Drago
Department of Transportation
1120 N Street, MS-49,
Sacramento, CA 95814
916-654-4677

Idaho Association of Soil Conservation Districts
1412 W. State Street, Suite 210
Boise, Idaho 83701
208-338-5900

Idaho Cooperative Extension Service
University of Idaho College of Agriculture
Agricultural Publications
University of Idaho
Moscow, Idaho 83844-2240
208-885-7982

Idaho Department of Agriculture
Agricultural Water Quality Program
P.O. Box 790
Boise, Idaho 83701-0790
208-332-8500

Department of Environmental Quality
1410 N. Hilton Street
Boise, ID 83706
208-373-0502

Idaho Department of Lands
Bureau of Forestry Assistance
3780 Industrial Ave.
Coeur d'Alene, ID 83815
208-769-1525

Idaho Department of Lands
Bureau of Minerals
954 West Jefferson
Boise, Idaho 83720-0050
208-334-0247

Idaho Department of Water Resources
1301 N. Orchard Street
Boise, ID 83706
208-327-7900

Idaho Soil Conservation Commission
P.O. Box 790
Boise, Idaho 83701-0790
208-332-8650

Idaho Transportation Department
3311 W. State St.
P.O. Box 7129
Boise, Idaho 83707-1129
208-334-8484

National Small Flows Clearinghouse
West Virginia University
P.O. Box 6064
Morgantown, WV 26506-6064.
800-624-8301

U.S. Department of Agriculture
Natural Resources Conservation Service
9173 West Barnes Drive, Suite C
Boise, Idaho 83709-1574
208-378-5700

U.S. Department of Agriculture
Forest Service – Northern Region
200 East Broadway Ave.
Missoula, MT 59807
406-329-3511

U.S. Department of Agriculture
Forest Service – Intermountain Region
325 25th Street
Ogden, UT 84401
801-625-5306

U.S. Environmental Protection Agency
National Headquarters – EPA Publications
1-800-490-9198

Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle, WA 98101
800-424-4372

Washington State Department of Transportation
Transportation Building
310 Maple Park Avenue SE
PO Box 47300
Olympia, WA 98504-7300
360-705-7000

Idaho Department of Environmental Quality
1410 North Hilton
Boise, ID 83702